May 20, 2015

STATE OF RHODE ISLAND AND PROVIDENCE PLANTATION
DEPARTMENT OF ADMINISTRATION

DIVISION OF PURCHASES BID NO. 7549548

RHODE ISLAND DEPARTMENT OF TRANSPORTATION

RHODE ISLAND CONTRACT NO.2015-CH-014

FEDERAL-AID PROJECT NO. FAP Nos: NHS-0102(009), NHSG-0102(010)

1R Improvements to Route 102 C-3

Harkney Hill Road to Old Plainfield Pike

CITY/TOWN OF Coventry, Foster

COUNTY OF KENT, PROVIDENCE

NOTICE TO PROSPECTIVE BIDDERS

ADDENDUM NO. 3 Prospective bidders and all concerned are hereby notified of the following changes in the Plans, Specifications, Proposal and Distribution of Quantities for this contract. These changes shall be incorporated in the Plans, Specifications, Proposal and Distribution of Quantities, and shall become an integral part of the Contract Documents.

A. Specifications-Job Specific

1. JS-i(R-1)

   Delete page JS-i(R-1) in its entirety and replace it with revised page JS-i(R-2) attached to this Addendum No. 3. Codes 401 and 414 have been deleted.

2. JS-5

   Delete Page JS-5 in its entirety and replace it with revised Page JS-5 (R-1) attached to this Addendum No. 3. The specification has been revised.

3. JS-16 through JS-39

   Delete pages JS-16 through JS-39 in their entirety and replace them with revised page JS-16(R-1) attached to this Addendum No. 3. Special provision Code 401 has been deleted.

4. JS-46

   Delete Page JS-46 in its entirety and replace it with revised Page JS-46(R-1) attached to this Addendum No. 3. Special provision Code 414 has been deleted.

B. Distribution of Quantities

1. Index Pages

   Delete Index Pages 1 through 3 in their entirety and replace them with revised Index Pages 1(R-2), 2 (R-2), and 3(R-2) attached to this Addendum No. 3. Items highlighted in bold have been revised.

2. Pages 14 & 15

   Delete Pages 14 and 15 in their entirety and replace them with revised Pages 14 (R-2) and 15(R-1) attached to this Addendum No. 3. Item 401.3310 has been deleted and Item 406.9901 has been revised.

3. Page 41

   Delete Page 41 in its entirety and replace it with revised Page 41(R-2) attached to this Addendum No. 3. Item T05.1000 has been added back to the contract. A new location has been added.

4. Page 50

   Delete Page 50 in its entirety and replace it with revised Page 50(R-1) attached to this Addendum No. 3. Item T06.5230 has been added.

C. Drawings/Plans - Change/Addition

1. Sheet No. 5

   Job specific Notes 3 and 4 have been added to Sheet No. 3 as shown on Sketch No. 1 attached to this Addendum No. 3.

2. Sheet No. 12

   Delete Sheet No. 12 in its entirety and replace it with revised Sheet No. 12(R-1)attached to this Addendum No. 3. Limits have been revised to accommodate conduit crossing the roadway for future use. Future loop detector locations(installed by others) added.

3. Sheet No. 22

   Delete Sheet No. 22 in its entirety and replace it with revised Sheet No. 22(R-1) attached to this Addendum No. 3. Sign locations have been revised, handhole and conduit have been added, and future loop locations have been shown.

D. Contract Documents

1. Compilation of Approved Specifications, April 2015

   Insert Compilation of Approved Specifications, April 2015 attached to this Addendum No. 3. This document is part of the Standard Contract Documents.

RI Department of Transportation
Chief Engineer

INDEX (R-2)

SPECIFICATIONS – JOB SPECIFIC

CODE 108.1000

PROSECUTION AND PROGRESS

In accordance with Section 108.08, Failure to Complete on Time, Para. a., Phased Completion, Interim Completion and Substantial Completion the following defines the Interim and Substantial Completion Dates and Associated Liquidated Damages:

Interim Completion: See Table Below

All Contract work shall be completed, as defined by Section 101.71, with the exception of final seeding and cleaning and flushing drainage.

Liquidated Damages: $1,750.00 per calendar day.

Substantial Completion: See Table Below

All Contract work shall be completed, as defined by Section 101.71.

Liquidated Damages: $450.00 per calendar day.

Award	Interim Completion	Substantial Completion
On or before July 4, 2015	03-Nov-15	03-Nov-15
July 5th thru August 3, 2015	20-Nov-15	03-May-16

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PAGES JS-17 THROUGH JS-39 DELETED

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Table of Contents - Distribution of Quantities

Project Name - 1R Improvements to Route 102 C-3
Estimate Name - Addendum No. 3
R.I. Contract No. - 2015-CH-014
FAP Nos: NHS-0102(009), NHSG-0102(010)

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Item No.	Item Code	Description	UM	Qty.	Pay Code	Seq. No.
019	401.1010 Cont.	688+00-797+00		8,560.00	0005	01
		Item 401.1010 Total:		**8,560.00**		
020	401.1210	**CLASS 19.0 HMA WITH WMA AND PAY ADJUSTMENTS**	**TON**			
		ROUTE 102				
		797+00-911+50		7,000.00	0005	01
		Item 401.1210 Total:		**7,000.00**		
024	403.0300	**ASPHALT EMULSION TACK COAT**	**SY**			
		PROJECT WIDE				
		FROM ITEM 401.1000		98,460.00	0005	01
		Item 403.0300 Total:		**98,460.00**		
025	406.9901	**FULL DEPTH RECLAIMATION WITH BITUMINOUS STABILIZER**	**SY**			

Distribution of Quantities

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R.I. Contract No. - 2015-CH-014
FAP Nos: NHS-0102(009), NHSG-0102(010)

Item No.	Item Code	Description	UM	Qty.	Pay Code	Seq. No.
025	406.9901 Cont.	RTE 102				
		688+00-695+00		3,130.00	0005	01
		695+00-707+50		5,070.00	0005	01
		707+50-726+25		7,827.00	0005	01
		727+50-732+50		2,130.00	0005	01
		732+50-738+00		3,335.00	0005	01
		738+00-757+50		8,125.00	0005	01
		757+50-770+00		5,275.00	0005	01
		770+00-782+50		5,000.00	0005	01
		782+50-797+00		5,905.00	0005	01
		797+00-807+50		4,150.00	0005	01
		807+50-820+00		4,931.00	0005	01
		820+00-832+50		5,453.00	0005	01
		832+50-857+50		10,278.00	0005	01
		857+50-882+50		10,278.00	0005	01
		882+50-907+50		10,414.00	0005	01
		907+50-911+50		2,286.00	0005	01
		Item 406.9901 Total:		**93,587.00**		
026	410.1000	**TEMPORARY PATCHING MATERIAL/TRENCHES**	**TON**			
		RTE. 102				
		694+20 RT		4.75	0005	01
		695+80 RT		2.50	0005	01
		696+30 RT		2.10	0005	01
		698+12 RT		2.25	0005	01
		698+70 RT		2.95	0005	01
		699+88 RT		3.10	0005	01
		700+30 RT		2.10	0005	01
		701+57 RT		2.75	0005	01
		703+95 RT		2.70	0005	01
		705+30 RT		2.95	0005	01
		706+00 RT		2.85	0005	01

Distribution of Quantities

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Estimate Name - Addendum No. 3
R.I. Contract No. - 2015-CH-014
FAP Nos: NHS-0102(009), NHSG-0102(010)

Item No.	Item Code	Description	UM	Qty.	Pay Code	Seq. No.
S085	T05.0100	**PRECAST TYPE A HANDHOLE STANDARD**	**EACH**			
		18.2.0				
		ROUTE 102				
		WATERMAN HILL ROAD/MAPLE		3.00	0021	02
		VALLEY ROAD INTERSECTION				
		Item T05.0100 Total:		**3.00**		

ntities

to Route 102 C-3
um No. 3
5-CH-014
SG-0102(010)

UM	Qty.	Pay Code	Seq. No.
	6,000.00	0005	01
Total:	**6,000.00**		
MA **TON**			
	4,900.00	0005	01
Total:	**4,900.00**		
LF			
	135.00	0005	01
Total:	**135.00**		

JOB SPECIFIC GENERAL NOTES

1. THE COST OF TRIMMING AND FINE GRADING FOR CURB INSTALLATION WILL BE INCLUDED IN THE COST OF THE CURB. THE TRIMMING AND FINE GRADING LIMITS SHALL BE A MINIMUM 1'–0" IN FRONT OF AND 1'–0" IN BACK OF THE NEW CURB OR TO A SUFFICIENT DISTANCE IN FRONT AND/OR IN BACK OF THE NEW CURB FOR PROPER CURB INSTALLATION.

2. THE CONTRACTOR SHALL FULLY UNDERSTAND THAT HE IS RESPONSIBLE FOR ALL FIELD SURVEY WORK NECESSARY TO SATISFY THE INTENT OF THE PROJECT.

3. TEMPORARY BITUMINOUS PATCH SHALL BE 2" THICK. THE CONTRACTOR SHALL USE TEMPORARY BITUMINOUS PATCH MATERIAL DURING CONSTRUCTION TO TEMPORARILY MATCH ROAD GUTTER ELEVATIONS TO EXISTING DRIVEWAY OPENINGS AS DIRECTED BY THE ENGINEER.

4. FOR THIS PROJECT ONLY, DRAINAGE AND EROSION CONTROL NOTES 5 AND 6 FROM SHEET "STANDARD NOTES –1" SHALL BE REPLACED WITH:

5. EXCELSIOR MATTING SHALL BE USED TO STABILIZE PLANTABLE SOIL AND/OR LOAM IN ALL DITCHES, ON ALL SLOPES ADJACENT TO WETLANDS AND WETLAND PERIMETERS, AND ON ALL SLOPES WITHIN WATER QUALITY BASINS.

6. SEEDING ON ALL SLOPES 3 TO 1 OR STEEPER SHALL CONSIST OF THE FOLLOWING APPLICATIONS UNLESS CHANGED IN THE CONTRACT.

   a. SEEDING TYPE II.

   b. EXCELSIOR MATTING.

Gordon R. Archibald, Inc. Civil and Environmental Engineers Pawtucket, Rhode Island	TITLE OF SKETCH 1R HIGHWAY IMPROVEMENTS TO ROUTE 102 **JOB SPECIFIC NOTES, LEGEND AND DETAILS**	R.I. CONTRACT NO. 2015–CH–014 SKETCH NO. 1
DATE: 5/15/2015	ADDENDUM NUMBER 3	REVISION TO SHEET NO. 5

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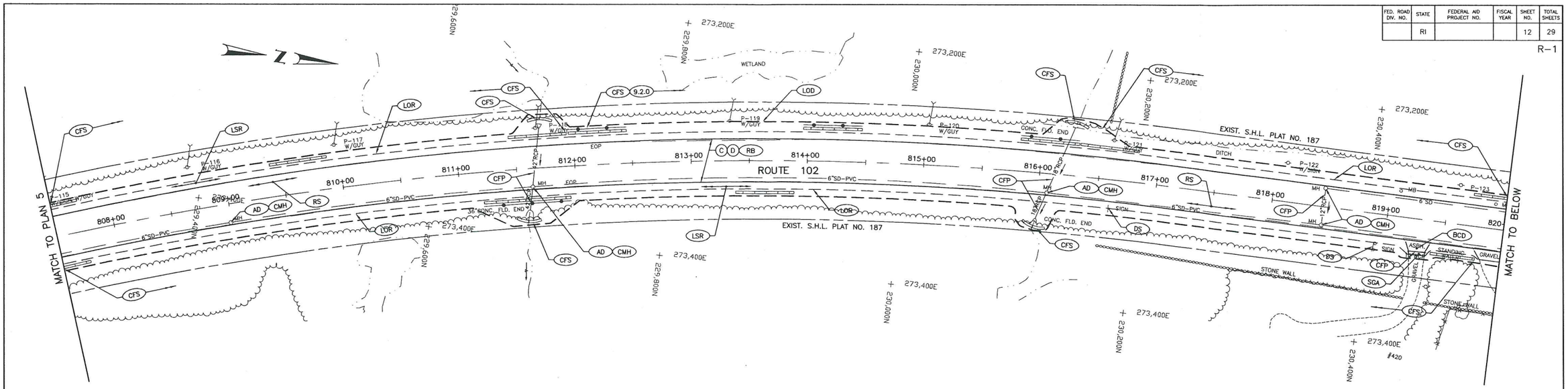
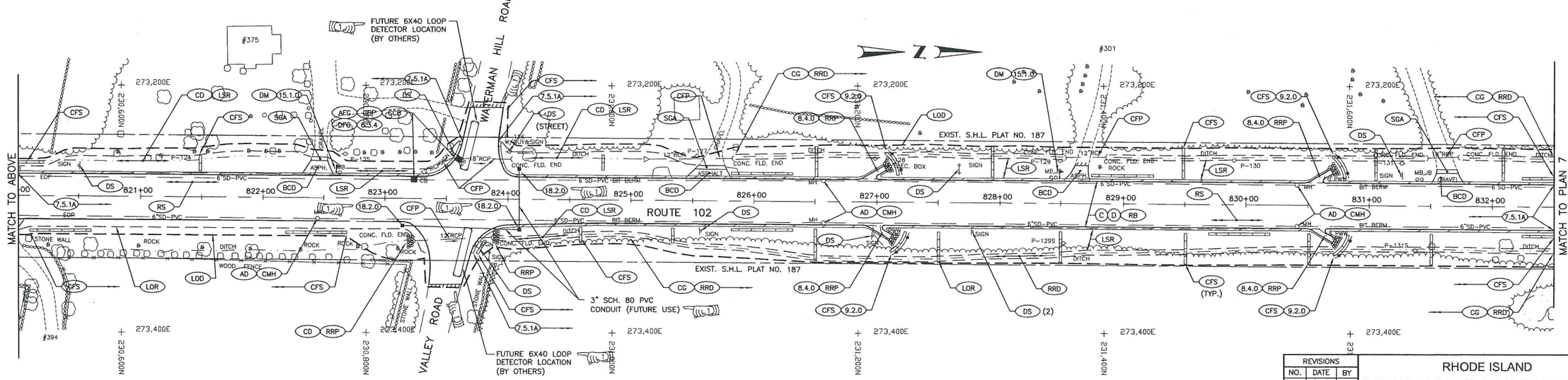
	RI			12	29

R-1





ADDENDUM NO. 3

REVISIONS		
NO.	DATE	BY
1	5/19/15	JMS

Gordon R. Archibald, Inc.
Civil and Environmental Engineers
Pawtucket, Rhode Island

RHODE ISLAND
DEPARTMENT OF TRANSPORTATION

1R HIGHWAY IMPROVEMENTS TO
ROUTE 102

COVENTRY & FOSTER, RHODE ISLAND

GENERAL PLAN 6

STA. 807+50 TO STA. 832+50

CHECKED BY _____ DATE _____ SCALE 1"=40'

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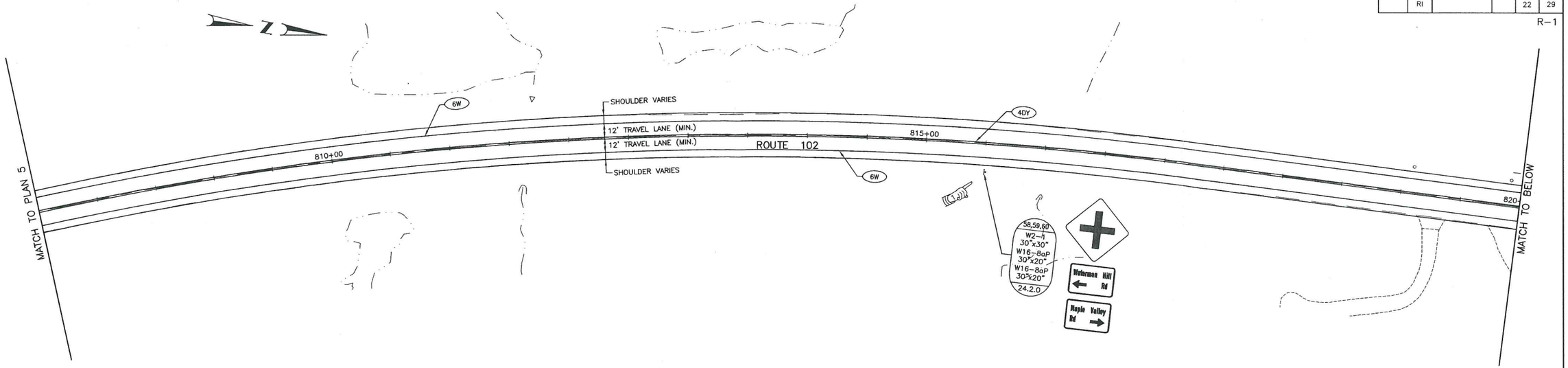
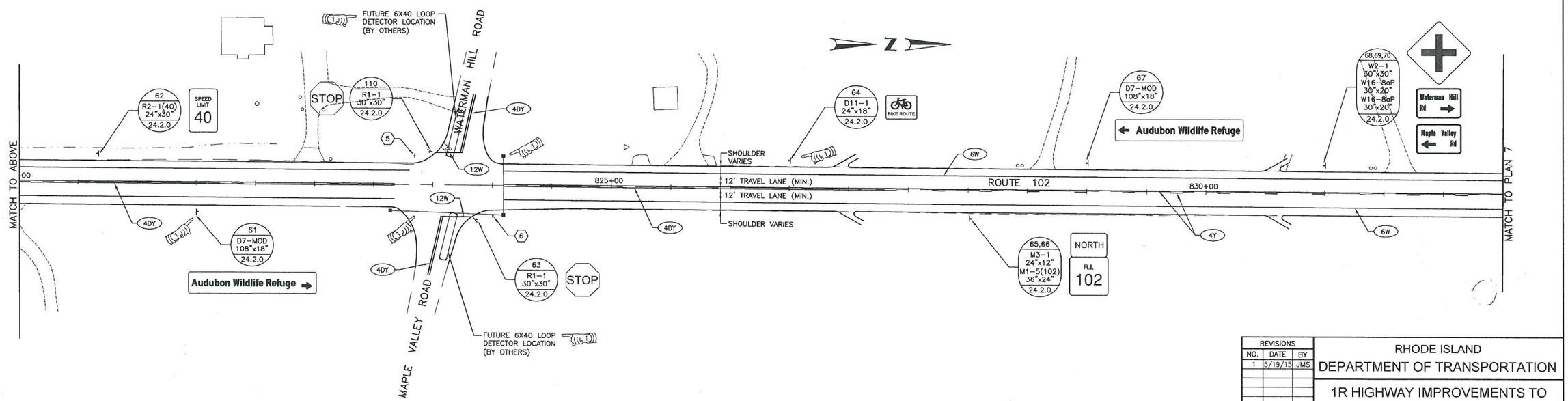
FED. ROAD DIV. NO.	STATE	FEDERAL AID PROJECT NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
	RI			22	29

R-1





ADDENDUM NO. 3

REVISIONS		
NO.	DATE	BY
1	5/19/15	JMS

Gordon R. Archibald, Inc.
Civil and Environmental Engineers
Pawtucket, Rhode Island

RHODE ISLAND
DEPARTMENT OF TRANSPORTATION

1R HIGHWAY IMPROVEMENTS TO
ROUTE 102

COVENTRY & FOSTER, RHODE ISLAND

SIGNING & STRIPING PLAN 6

STA. 807+50 TO STA. 832+50

CHECKED BY _____ DATE _____ SCALE 1"=40'

0172Y_V1_022_SIGNSTPE006_ADD_03

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COMPILATION OF APPROVED SPECIFICATIONS

RHODE ISLAND DEPARTMENT OF TRANSPORTATION
STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION

REVISIONS
SUPPLEMENTAL SPECIFICATIONS
SPECIAL PROVISIONS

SUPPLEMENT NO. 15

APRIL 2015

TABLE OF CONTENTS

Add the following subsections to **Section 201; Site Preparation**, pages 2-1 through 2-11 of the RI Standard Specifications for Road and Bridge Construction.

SECTION 201

LOAD AND HAUL SOLID WASTE
DISPOSAL OF SOLID WASTE

201.01 DESCRIPTION.

201.01.13 Load and Haul Solid Waste and Disposal of Solid Waste. This work consists of collecting, loading, hauling and disposing of on-site solid waste material, including but not limited to trash, litter, household appliances, tires, vegetative and other on-site debris.

Unless otherwise provided for in the contract documents, this item of work shall not include the removal and disposal of solid waste material or debris generated by the Contractor's construction operations, including soil and rock excavation, the removal of pavement, sidewalks and other highway infrastructure, clearing and grubbing operations and/or the removal and disposal of contaminated soils.

201.02 MATERIALS.

201.02.1 Load and Haul Solid Waste and Disposal of Solid Waste: Regulatory Provisions. The Contractor shall ensure that the removal of all debris is conducted in a manner consistent with the requirements of the Rhode Island Building Code and OSHA standard 29 CFR 1926: Safety and Health Regulations for Construction.

Solid waste materials shall be disposed of in accordance with EPA regulations (40 CFR 239 – 259, including latest revisions) and RIDEM solid waste regulations (DEM OWM-SW-04-01, including latest revisions), and any and all other applicable regulations.

The Contractor shall obtain all required permits for hauling and disposal of waste materials, and shall be responsible for payment of tipping and other required fees.

201.03 CONSTRUCTION METHODS.

201.03.13 Load and Haul Solid Waste and Disposal of Solid Waste. The removal of solid waste material from the project site shall be performed with the necessary labor, tools and equipment in a manner such that the effects of noise, dust and other adverse conditions are minimized.

All solid waste material shall be legally recycled or disposed of at licensed facilities.

The Contractor shall notify the Engineer in the event hazardous waste materials are encountered or may be present, including but not limited to contaminated soils, oil and/or other hazardous or potential

hazardous waste materials (OHM). The removal of OHM materials shall be conducted in accordance with applicable state and federal regulations, and shall not be handled under this item of work.

201.04 METHOD OF MEASUREMENT.

201.04. Load and Haul Solid Waste and Disposal of Solid Waste. "Load and Haul Solid Waste" and "Disposal of Solid Waste" will be measured by the number of tons of waste material actually disposed of. The tonnage will be determined from weight slips generated at the waste disposal facilities.

201.05 BASIS OF PAYMENT.

201.05.13 . Load and Haul Solid Waste and Disposal of Solid Waste. "Load and Haul Solid Waste" and "Disposal of Solid Waste" will be paid for by their respective contract unit bid prices per ton as listed in the Proposal. The prices so-stated constitute full and complete compensation for all disposal fees, recycling of waste materials, labor, materials, equipment and all incidentals required to finish the work, complete and accepted by the Engineer.

Remove **Section 401; Dense Graded Bituminous Concrete Pavements**, pages 4-1 through 4-19 of the RI Standard Specifications for Road and Bridge Construction, pages AC-15 to AC-17 of the January 2011Specification Compilation and page AC13-1 of the April 2012 Specification Compilation in its entirety and replace it with the following.

SECTION 401

DENSE GRADED HOT MIX ASPHALT (HMA) PAVEMENTS

401.01 DESCRIPTION. This work consists of constructing HMA pavements on prepared foundations in conformity with the dimensions and details indicated on the Plans, and in accordance with these Specifications. These Specifications are applicable to all types of Dense Graded HMA pavements irrespective of aggregate gradation, grade of performance graded asphalt binder (PGAB), or pavement use.

The HMA shall be composed of a mixture of aggregate, PGAB, and filler if required. The aggregate shall be sized, graded and combined in such proportions that the resulting mixture meets the gradation requirements of the job mix formula (JMF).

401.02 MATERIALS.

401.02.1 Aggregates. Aggregates shall meet the applicable requirements of **Subsection M.03.02.2** of these Specifications and AASHTO M 323.

401.02.2 Performance Graded Asphalt Binder (PGAB). All grades shall conform to AASHTO M 320 and R 29. The PGAB shall meet the requirements of PG 64S-28 with the exception of both Class 19.0 and mixes designated as “Base Course” which shall incorporate PG 64S-22 for mixes with less than 15% RAP. Both Class 19.0 and “Base Course” mixes with 15 to 25 percent RAP shall incorporate PG 58S-28.

Should a class of HMA be designated as “Modified”, the binder shall meet the requirements of PG 64E-28 and shall incorporate at least 2.0% SBS polymer. The nonrecoverable creep compliance versus percent recovery of the binder shall be plotted and must fall above the curve in Figure X1.1 in Appendix X1 of AASHTO M 332.

Should a class of HMA be designated as “with WMA” the Contractor shall use a WMA (Warm Mix Additive). WMA shall conform to Section 414 of these specifications.

Re-refined engine oil bottoms (REOB) shall not be used in any PGAB.

401.02.3 Mix Design. HMA mixes shall conform to AASHTO M 323, "Standard Specification for Superpave Volumetric Mix Design". The design procedure shall follow AASHTO R 35 "Standard Practice for Superpave Volumetric Design for Hot-Mix Asphalt (HMA)". The optimum binder content (OBC) shall be determined as follows:

a) The OBC for Class 4.75, Class 9.5, and Class 12.5 when not designated as “Base Course” shall be determined using PG 64S-28.

b) The OBC for Class 4.75, Class 9.5, and Class 12.5 when designated as "Base Course" with less than 15 percent RAP shall be determined using PG 64S-22.

c) The OBC for Class 4.75, Class 9.5, and Class 12.5 when designated as "Base Course" with 15 to 25 percent RAP shall be determined using PG 58S-28.

d) The OBC for Class 19.0 with less than 15 percent RAP shall be determined using PG 64S-22.

e) The OBC for Class 19.0 with 15 to 25 percent RAP shall be determined using PG 58S-28.

The effective voids in the mineral aggregate ($VMA_{effective}$) and a volumetric phase diagram shall be submitted for each asphalt content during the mix design process. Mix designs shall be developed and signed by an individual certified in "Superpave HMA Mix Design" by the Asphalt Institute. Mix Designs shall be submitted no later than two weeks prior to the date when production of the mixture is scheduled to begin and shall be accompanied by a copy of that individual's certification. No mixture may be produced for State projects until the mix design is approved by the Engineer. Mix designs shall be submitted on forms provided by the Engineer.

The following specific requirements and exceptions to AASHTO M 323 shall apply.

a. The specific gravity, absorption and consensus properties of the aggregates shall be obtained from RIDOT's most recent sampling and testing or from a laboratory accredited to perform AASHTO T 84 and T 85.

b. The implementation of the recommendations of Section 4.2 of AASHTO R 35 is required.

c. The mix shall be coarse graded as defined in Section 6.1.3 of AASHTO M 323.

d. The dust to binder ratio ($P_{0.075}/P_{be}$) shall be 0.5 – 1.0. The effective binder content shall be used to calculate this ratio.

e. In addition to the sieves listed in Table 3 of AASHTO M 323, the 0.600 mm, 0.300 mm and 0.150 mm sieves are required. The 50.0 mm and 37.5 mm sieves are not required.

f. Class 19.0 and mixes designated as "Base Course" shall be designed with a 0%, 10%, 15%, 20% or 25% RAP content. RAP shall not be used in any other mix.

g. $N_{initial}$ shall be 6, N_{design} shall be 50 and N_{max} shall be 75 gyrations.

h. A moisture susceptibility test is not required.

i. The design VMA, VFA, air voids and minimum optimum binder content (OBC) shall meet the following criteria:

Table 1 – HMA Properties

Class of Mix	VMA (minimum)	VFA	Air Voids	Minimum OBC
4.75	17.5%	70% - 80%	4%	7.0
9.5	16.5%	70% - 80%	4%	6.0
12.5	15.5%	70% - 80%	4%	5.5
19.0	14.5%	70% - 80%	4%	5.0

The following procedures shall be adhered to for each mix design:

- Three aggregate trial blends shall be submitted for acceptance before beginning the mix design procedure.

The procedures for mix design submittals shall include:

- All trial mixture data and calculations determined per Section 9 of AASHTO R 35 shall be submitted on forms provided by the Engineer. The Engineer will determine which trial mixture shall be used for the mix design procedure.

- After the mix design is completed it shall be submitted to the Engineer for review and approval.

- The correction factors for each mix for each ignition furnace in the plant lab shall be provided.

The two gyratory cores (AASHTO T 308) and the theoretical maximum specific gravity sample (AASHTO T 209) at the optimum binder content shall be submitted to the Engineer.

Before beginning production of a new HMA mix, a successful plant trial batch shall be performed for that mix and the results forwarded on forms provided by the Engineer.

Should a change in sources of materials be made, a new mix design shall be established before the new material is used. When unsatisfactory results or other conditions make it necessary, the Contractor shall establish a new mix design and submit it to the Engineer for approval.

401.02.4 Quality Assurance.

a. Process Control. The Contractor shall exercise process control over all production operations. This shall require the constant monitoring of equipment, materials, and production activity such as testing and analysis to ensure that the HMA meets all applicable requirements and is produced within the allowable tolerances.

b. Acceptance Testing. Acceptance testing will be conducted by the Engineer.

1. Gradation, Binder Content and Air Void Content

The gradation requirements in Table 2 apply to mixes with and without pay adjustments:

Table 2 – Gradation Requirements

	Class 19.0	**Class 12.5**	**Class 9.5**	**Class 4.75**
25.0mm (1”)	100%	100%	100%	100%
19.0mm (3/4”)	90% - 100%	100%	100%	100%
12.5mm (1/2”)	90% max	90% - 100%	100%	100%
9.5mm (3/8”)	-	90% max	90% - 100%	95% - 100%
4.75mm (#4)	-	-	90% max	85% - 100%
2.36mm (#8)	± 5% from design	± 5% from design	± 5% from design	-
1.18mm (#16)	-	-	-	±5% from design
0.075mm (#200)	≥2%	≥2%	≥2%	≥2%
Control Sieve	2.36mm (#8)	2.36mm (#8)	2.36mm (#8)	1.18mm (#16)

During production of a specific mix, if two consecutive tests do not meet the gradation requirements of Table 2 or one test exceeds double the tolerance on the control sieve, the plant shall cease production of that HMA mix. Production will be allowed to resume after the Contractor completes a successful trial batch for that class of mix, as approved by the Engineer.

The plant shutdown criteria in Table 3 shall apply for binder content and air voids that exceed the following tolerances:

Table 3 – Plant Shutdown Criteria

Pay Adjustments	Shutdown Criteria	One Test	Two Consecutive Tests
With Pay Adjustments	Optimum Binder Content	±0.6%	-
	Design Air Voids	±2.0%	-
Without Pay Adjustments	Optimum Binder Content	±0.6%	±0.4%
	Design Air Voids	±2.0%	±1.0%

Production will be allowed to resume after the Contractor completes a successful trial batch for that class of mix, as approved by the Engineer.

2. Mix Production – Lots and Sublots.

A standard sublot is 600 tons for HMA sampled at the plant for each production run. A standard lot for each mix is ten sublots. A sample will be randomly selected and tested for each sublot. At least five sublots will be used when calculating pay adjustments.

If the quantity of HMA needed to finish a production run is projected by the Contractor to be less than the standard sublot size of 600 tons, the projected tonnage may be used to select a random sample. If the projected tonnage is not produced or a random sample is unable to be taken, the Engineer may select a sample at the end of the run or at the paver. If no sample is taken, the tonnage will be added to the previous sublot.

Additional samples may be taken at the discretion of the Engineer.

Gyratory cores and theoretical maximum density samples will be retained by the Engineer for two weeks after the results are reported to the Contractor.

3. Adjustments to Lots.

If less than five sublots are tested after the end of the final standard lot, they will be added to that lot. Five or more sublots tested after the end of the final standard lot will constitute a separate lot.

4. Plant Pay Adjustments.

(a) If a class of HMA is designated with "Pay Adjustments", the pay adjustments for deviation from the optimum binder content (established by the mix design) in Table 4 and the design air void content in Table 5 will apply:

Table 4 – OBC Pay Adjustments

Deviation from Optimum Binder Content	Pay Adjustment
Less than or equal to 0.1 %	+2%
0.2%	+1%
0.3%	0%
0.4%	-5%
0.5%	-15%
0.6%	-30%
0.7%	-40%
Greater than 0.7 %	-50% or Remove and Replace*

Table 5 – Air Void Pay Adjustments

Deviation from Design Air Void Content	Pay Adjustment
Less than or equal to 0.5%	+1%
0.6% to 1.0%	0%
1.1% to 1.5%	-5%
1.6% to 2.0%	-10%
2.1% to 2.5%	-30%
2.6% to 3.0%	-40%
Greater than 3.0%	-50% or Remove and Replace*

* The decision to make 50% payment or Remove and Replace will be made by the Engineer

Note: All deviation values will be rounded to the nearest 0.1% before applying pay adjustments.

(b) Calculation of Pay Adjustments for Production Binder and Air Void Content.

For each test, absolute deviations will be used when determining binder and air void content pay adjustments. Absolute deviations are the values of deviation regardless of sign (±).

The average of the absolute deviations from the optimum binder content of all of the sublots in each lot will be used to determine the appropriate pay adjustments for the lots. The same will apply for air void content. No payment will be made for any pavement that is removed.

All other tolerances shall conform to the RI Standard Specifications.

c. Independent Assurance Testing. This testing will be performed by the Department in accordance with the Rhode Island Department of Transportation publication entitled "Schedule for Sampling, Testing and Certification of Materials."

401.03 CONSTRUCTION METHODS.

401.03.1 HMA Mixing Plant. Mixing plants shall be of sufficient capacity and coordinated to adequately handle the proposed production of HMA. The storage yard shall be maintained neat and orderly and the separate stockpiles shall be readily accessible for sampling.

a. Requirements for All Plants.

1. Equipment for Preparation of PGAB. Tanks provided for the storage of PGAB shall be equipped to heat and hold the material at the required temperatures. The heating shall be accomplished by steam coils, electricity, or other approved means such that no flame shall be in contact with the tank. The circulating system for the PGAB shall be designed to assure proper and continuous circulation during the operating period. Provision shall be made for measuring storage tanks. An adequate sampling valve shall be provided to ensure the safe and proper sampling of the PGAB.

2. Cold Feed Bins. The plant shall include no fewer than three (3) storage bins of sufficient capacity to supply the mixer when it is operating at full capacity. Bins shall be arranged to assure separate and adequate storage of appropriate fractions of the mineral aggregates without contaminations. They shall also be so constructed that samples can be readily obtained. Separate dry storage shall be provided for filler or hydrated lime when used and the plant shall be equipped to feed such material into the mixer.

3. Cold Aggregate Feeder. The plant shall be provided with accurate mechanical means for uniformly feeding the aggregate into the drier so that uniform production and temperature will be obtained.

4. Drier. The plant shall include a drier or driers which continuously agitate the aggregate during the heating and drying process.

5. PGAB Control Unit. Satisfactory means, either by weighing or metering, shall be provided to obtain the proper amount of PGAB in the mix within the tolerance specified. Means shall be provided for checking the quantity or rate of flow of PGAB into the mixer.

6. Thermometric Equipment. An armored thermometer of adequate range in temperature reading shall be fixed in the PGAB feed line at a suitable location near the charging valve at the mixer unit.

The plant shall also be equipped with either an approved dial-scale, mercury-actuated thermometer, an electric pyrometer, or other approved thermometric instrument so placed at the discharge chute of the drier as to register automatically the temperature of the exiting material.

The Engineer may require replacement of any malfunctioning or inconsistent thermometer by an approved temperature sensing and recording apparatus for better regulation of the temperature of the material.

7. Dust Collector. The plant shall be equipped with a dust collector constructed to waste or return uniformly all or any part of the material collected as directed.

8. Truck Scales. When required, the HMA shall be weighed on approved scales furnished by the Contractor or on public scales at the Contractor's expense. Such scales shall be tested at least every 60 days or whenever the Engineer deems necessary to assure their accuracy.

9. Scales. Scales shall be so located as to be easily readable from the operator's normal work station; otherwise a remote readout shall be supplied.

All plant scales, including truck scales, shall be certified at the expense of the Contractor by a competent and experienced scales technician as follows:

(a) Annually prior to use in State work.

(b) At intervals of not more than 60 calendar days.

(c) At any time ordered by the Engineer.

10. Safety Requirements. Adequate and safe access to sampling points shall be provided. Guarded ladders to other plant units shall be placed at all points where accessibility to plant operations is required. Accessibility to the top of truck bodies shall be provided by a platform or other suitable device, placed in an acceptable location near the testing laboratory, to enable the Engineer to obtain samples and mixture temperature data. All gears, pulleys, chains, sprockets, and other dangerous moving parts shall be thoroughly guarded and protected. A clear, clean and unobstructed passage shall be maintained at all times in and around the truck loading area.

11. HMA Holding Bin. HMA may be stored in surge and storage systems designed for that purpose. Each surge and storage system must meet the requirements of AASHTO M156, unless otherwise permitted by the Engineer, and may be inspected by the Department to determine acceptance at specific holding times.

Acceptance shall be based upon the ability of the holding bin to hold and discharge mixtures within the quality criteria specified by the mix design and these Specifications.

b. Requirements for Batching Plants.

1. Automatic Proportioning. The plant shall be equipped with automatic proportioning devices. Such devices shall include equipment for accurately proportioning the various components of the mixture by weight in the proper sequence. PGAB and aggregates shall be proportioned by weight. Additives, if required, may be proportioned by volume or weight. The plant shall be equipped to automatically control the sequence and timing of mixing operations. There shall be auxiliary interlock cutoff circuits to interrupt and stop the automatic cycling of the batching operations at any time an error in weighing occurs, when an aggregate bin becomes empty, or when there is a malfunction of any portion of the control system.

2. Recording Equipment. The plant shall be equipped with a digital recorder which will automatically print the following data on delivery tickets:

(a) Batch weights of each size aggregate. Weights printed may be individual or cumulative.

(b) Total weight of aggregates in batch. The weight printed for the last aggregate batched shall be the total weight of aggregates in the batch when cumulative weights are used.

(c) Weight of PGAB in batch.

(d) Weight of total batch.

(e) Total weight of batches in truck.

(f) Total weight of PGAB in all batches in truck.

(g) Date mixed.

(h) The time each batch or load began or the time each was completed.

When silos are utilized, the requirements for delivery tickets shall conform to **Para. c; Requirements for Drum Dryer Mixing Plants**, of this Subsection. In addition, automated batch plant printout tickets generated in accordance with **Para. b** of this Subsection shall be given to the plant inspector and maintained on file.

There shall be sufficient copies of delivery tickets to provide a copy for the plant inspector and a copy for the Resident Engineer for permanent project record. The following information shall also be included on delivery slips:

(i) Name of customer.

(j) Name of project and contract number.

(k) Name of driver and truck number.

(l) Class of HMA.

(m) Additives.

3. Equipment Failure. If at any time the automatic proportioning or recording devices become inoperable, the plant may be allowed to batch and mix HMA for a period of not more than 48 hours from the time of the breakdown, if approved by the Engineer. Written permission of the Engineer will be required for periods of operation without automatic proportioning facilities longer than 48 hours.

4. 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.

5. Hot Aggregate Bins. Hot bin storage of sufficient capacity to ensure uniform and continuous operation shall be provided. The bins shall be arranged to ensure separate and adequate storage of appropriate fractions of the aggregate. Each bin shall be provided with overflow pipes, of such size and at such locations as to prevent backing up of material into other compartments or bins. Each bin shall be provided with its individual outlet gate, constructed so that when closed there shall be no leakage. The gates shall cut off quickly and completely. Bins shall be equipped with adequate tell-tale devices to indicate the position of the aggregates in the bins at the lower quarter points. Adequate and convenient facilities shall be provided for obtaining aggregate samples from each hot bin.

6. Aggregate Scales. Scales for any weigh box or hopper shall be of the springless dial type, having a full complement of index pointers and shall be of a standard make and design. They shall be

accurate to 0.50 percent, have minimum graduations not greater than 0.50 percent and shall be readable and sensitive to 0.25 percent or less. The preceding percentages are based on total batch weight.

7. Batching Controls. Batching controls shall be electrically interlocked with the scales to prevent cycling or recycling of batching until scales tare zero.

The batching controls shall meet the following tolerances with respect to the various components weighed in each batch:

Combined Aggregate Components:	±1.5 percent of total batch weight
PGAB:	±0.1 percent of total batch weight

The total weight of the batch shall not vary more than plus or minus 2 percent from the theoretical design weight.

8. Time Locking Device. The mixer shall have an accurate time locking device to control the operation of a complete mixing cycle by locking the weigh box gate, after charging the mixer, until the closing of the mixer discharge gate at the completion of the cycle. It shall lock the PGAB feed throughout the dry mixing period and shall lock the mixer discharge 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 commencement of application of the PGAB. The wet mixing period is the interval of time between the commencement of application of the PGAB and the opening of the mixer discharge gate.

The control of the timing shall be flexible and capable of being set at intervals of not more than five seconds throughout the cycles up to three minutes. Changes in mixing time shall be made only when ordered by the Engineer.

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

10. PGAB Control. The equipment used to measure the PGAB shall be accurate to plus or minus 0.5 percent. The PGAB bucket shall be a non-tilting type with a loose sheet metal cover. The length of the discharge opening trough, bucket or spray bar shall be not less than three-fourths the length of the mixer and it shall discharge directly into the mixer. The PGAB bucket, its discharge valve or valves 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 PGAB scales. The capacity of the PGAB bucket shall be at least 15 percent in excess of the weight of PGAB required in any batch. The plant shall have an adequately heated quick-acting, non-drip, charging valve located directly over the PGAB bucket.

The indicator dial shall have a capacity of at least 15 percent in excess of the quantity of PGAB used in a batch. The controls shall be constructed so that they may be locked at any dial setting and will automatically reset to that reading after the addition of PGAB to each batch. The dial shall be in full view

of the mixer operator. The flow of PGAB shall be automatically controlled so that it will begin when the dry mixing period is over. All of the PGAB required for one batch shall be discharged in not more than 15 seconds after the flow has started. The size and spacing of the spray bar openings, trough or PGAB bucket shall provide a uniform application of PGAB the full length of the mixer. The section of the PGAB line between the charging valve and the spray bar shall be provided with a valve and outlet for checking the meter when a metering device is substituted for a PGAB bucket.

11. Mixer. The batch mixer shall be 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 one inch unless the maximum diameter of the aggregate in the mix exceeds 1¼-inches, in which case the clearance shall not exceed 1½-inches.

12. Access to the mixer platform shall be by adequate and safe stairways. A hoist or pulley system shall be provided to raise scale calibration equipment, sampling equipment, and other similar equipment from the ground to the mixer platform and return. There shall be adequate and unobstructed space on the mixer platform.

c. Requirements for Drum Dryer Mixing Plants.

1. Proportioning. Aggregates and PGAB shall be proportioned by dry weight of the aggregate. Additives, if required, may be proportioned by volume or weight. The cold aggregate feeder shall be synchronized with the PGAB delivery system. Satisfactory means shall be provided to ensure positive interlocking control between each cold bin, the cold aggregate feeder, and the PGAB delivery system. This interlocking control shall be such that production is interrupted if one or more cold bins becomes empty, or the flow of either aggregate or PGAB is obstructed.

2. Recording Equipment. The plant shall be equipped with a digital recording device approved by the Engineer by which the proportion of aggregate supplied by each cold bin, the flow rates by weight of dry aggregate and of PGAB, and the cumulative weights of dry aggregate and of PGAB incorporated in the mix are automatically printed. These printed records, showing the date and time of printing, shall be provided to the Engineer at the start and at the end of each production period and at any other times or intervals of time as requested.

The plant shall also have a computerized scale system consisting of a weight batcher and/or a truck scale. Delivery tickets shall be printed on an automatic digital recorder which will print the following information on delivery tickets:

(a) Date loaded.

(b) Net weight of mixture in truck. When a truck scale is used the net weight of the mixture shall be automatically calculated by weighing the truck both empty and full.

(c) Time of each load.

There shall be sufficient copies of delivery tickets to provide a copy for the plant inspector and a copy for the Resident Engineer for permanent project record. The following information shall also be included on delivery slips:

(a) Name of customer.

(b) Name of project and contract number.

(c) Truck identification and name of driver.

(d) Class of HMA.

(e) Additives.

3. Equipment Failure. If at any time the automatic recording device or the computerized scale system become inoperable, the plant may be allowed to produce HMA for a period of not more than 48 hours from the time of the breakdown, if approved by the Engineer. Approval will not be granted unless a satisfactory arrangement is made by the Contractor to weigh the mix. Written permission of the Engineer will be required for periods of operation longer than 48 hours during which any required automatic system is not functioning properly.

4. Aggregate Storage. Sufficient storage space shall be provided for each stockpile of various sized aggregates which shall be kept separated until they have been introduced into the cold bins that feed the drier. A minimum of four cold feed bins shall be required.

5. Cold Feed System. The plant shall have a device at each cold bin to feed the aggregate accurately and uniformly. No gravity type feeders will be permitted. Each adjustment opening shall be provided with indicators graduated to allow proportioning. Each cold bin gate shall be interlocked in such a manner that production is interrupted if one or more cold bins becomes empty or the flow is obstructed.

A mineral filler bin, when required, shall be added to the standard plant cold feed bins, and shall feed the mineral filler at adjustable rates accurately and uniformly. The feeder shall be interlocked so that production is interrupted if the bin becomes empty or the flow is obstructed.

The weighing equipment for all aggregates including mineral filler shall consist of a continuous weighing device either as it is proportioned by the individual feeders or after all materials have been deposited on a common belt. Belt scales shall meet the requirements of N.B.S. Handbook 44 and shall be installed according to the scale manufacturer's recommendations.

The plant shall have an adjustable feed rate control for each aggregate cold bin feeder and mineral filler feeder. The plant shall proportion the total aggregate quantity to the drum mixer with such accuracy and uniformity that the variation of material per interval of time shall not exceed an amount equal to 1.5 percent of the total weight of HMA per interval of time.

An automatic aggregate sampling device shall be provided which will divert a representative combined aggregate sample, including mineral filler, into a hopper or container for the purpose of

gradation testing. The container shall cut the full width and depth of the aggregate flow. The sampling point shall be after the aggregate is proportioned and prior to its mixing with PGAB.

6. PGAB Control Unit. The PGAB shall be proportioned by a meter accurate to 0.1 percent. A flow switch designed to interrupt production if the PGAB flow is discontinued shall be installed in the delivery line between the meter and the mixer.

The PGAB delivery system shall be coupled with the aggregate delivery system to automatically maintain the required proportions as the aggregate flow varies. The delivery tolerance for PGAB shall be ±0.2 percent of the total mixture weight.

7. Plant Calibration. The cold feed and PGAB delivery systems shall be calibrated to insure that the plant is operating within the allowable tolerances. A procedure acceptable to the Engineer and in accordance with the manufacturer's recommendations shall be followed. These calibrations shall be performed prior to the start of each paving season, and at any other time as directed by the Engineer.

8. Mixer Unit. The plant shall include a continuous mixer unit having an automatic burner control and capable of producing a uniform mixture within the job mix tolerances. The mixture shall be discharged into a HMA holding bin meeting the requirements of **Para. a.11** of this Subsection.

The moisture content of the mixture upon discharge from the mixer shall not exceed 1.5 percent by weight.

401.03.2 Hauling Equipment. Trucks or other equipment used for hauling HMA shall have tight, clean, smooth metal beds which have been thinly coated with an approved release agent. No diesel fuel or other material is to be applied to any portion of the vehicle that comes into contact with the HMA. Any hauling equipment not complying with these Specifications will be immediately rejected along with its load of HMA. Each truck shall have a cover of canvas or other suitable material of such size as to protect the mixture from the weather. Truck beds shall be securely covered and, if necessary, insulated to ensure delivery of the mixture at the specified temperature. Cleaning of equipment, vehicles, and truck beds in areas to be paved is prohibited. Any HMA placed in areas where cleaning takes place is subject to rejection by the Engineer.

a. Material Transfer Vehicle (MTV). A material transfer vehicle (MTV) is required for the construction of all HMA friction, surface, intermediate and base courses on all limited access highways. When friction course is used, both the friction course and the underlying layer must be placed using an MTV.

The MTV shall independently deliver HMA from the hauling equipment to the paving equipment. A paving hopper insert with a minimum capacity of 14 tons shall be installed in the hopper of conventional paving equipment when a MTV is used.

As a minimum, the MTV shall have a high capacity truck unloading system which will receive HMA from the hauling equipment; a storage system in the MTV with a minimum capacity of 15 tons of HMA, and a discharge conveyor with the ability to swivel to either side to deliver the mixture to the paver while allowing the MTV to operate from an adjacent lane. In addition, the paving operation must contain a remixing system to blend the mixture prior to placement. The speed of the paver and MTV shall be adjusted to coordinate with the availability of HMA. Failure to keep the MTV supplied with HMA may be cause to cease paving operations for that operation. However, more than 2 stoppages shall result in paving being ceased for that operation.

When an MTV is to be used on a project, the Contractor shall further investigate the possible movement of the fully or partially loaded MTV on the project. If there are any structures on the project that the fully or partially loaded MTV will traverse, the Contractor shall request an Overweight Permit Check from the Department. Such a request shall be made in writing, and shall include the axle configuration, weights, and the project limits. Operations shall not begin until this permission is received from the Department and one copy forwarded to the Engineer.

The following is a statewide list of limited access highways (included are travel lanes, auxiliary lanes, climbing lanes, acceleration and deceleration lanes, ramps, collector/distributor roads, service roads, and shoulders greater than 8 feet):

I-95	Connecticut State Line to Massachusetts State Line
I-195	I-95 to Massachusetts State Line
I-295	I-95 to Massachusetts State Line
US Route 1	Prosser Trail to Wakefield Cut-Off
RI Route 4	Route 1 to I-95
US Route 6	Route 102 to Route 101; Route 10 to I-295
RI Route 10	Park Avenue to Route 6
US Route 6/RI Route 10	Magnolia Street Bridge to I-95
RI Route 24	Route 114 to Massachusetts State Line
RI Route 37	Natick Avenue to Post Road
RI Route 78	Route 1 to Connecticut State Line
RI Route 99	Route 146 to Mendon Road
East Shore Expressway	I-195 to Wampanoag Trail
RI Route 114	East Shore Expressway to Forbes Street
RI Route 138	Route 1 to Admiral Kalbfus Road
RI Route 146	I-95 to Reservoir Road
RI Route 146	Route 146A to Massachusetts State Line
RI Route 403	Route 4 to Quonset Point
Airport Connector	I-95 to Post Road
Henderson Bridge Access Roadway	Waterman Street/So. Angell Street to Broadway

401.03.3 Pavers. Unless otherwise shown on the Plans, mixtures shall be spread by means of a mechanical self-powered paver capable of spreading the mixture true to line, grade and crown as approved by the Engineer.

HMA pavers shall be self-contained, power-propelled units, provided with activated vibratory screed and solid vibratory screed extenders and capable of spreading and finishing courses of plant mixed HMA in lane widths applicable to the specified typical section and thickness shown on the Plans. Pavers used for shoulders and similar construction shall be capable of spreading and finishing courses of HMA in the widths, depths and cross slopes indicated on the Plans.

When laying mixtures, the paver shall be capable of being operated at forward speeds consistent with satisfactory laying of the mixture.

The paver shall be equipped with a receiving hopper having sufficient capacity for a uniform spreading operation. The hopper shall be equipped with a distribution system to place the mixture uniformly in front of the screed.

a. Screeding. The screed and screed extenders shall continually vibrate while placing the mixture and shall effectively produce a finished surface of the required evenness and texture without tearing, shoving or gouging the mixture. The screed shall be heated to maintain the HMA at the required placement temperature. Unless otherwise permitted by the Engineer, the screed extenders shall not extend more than two feet from the edge of the augers or auger extensions.

The paver shall be equipped with automatic screed controls with sensors for either or both sides of the paver, capable of sensing grade from an outside reference line, sensing the transverse slope of the screed and providing the automatic signals which operate the screed to maintain the desired grade and transverse slope. The sensor shall be capable of operating from a ski-type device or reference beam of not less than 25 feet in length. The sensor shall also have the capability of operating from a reference line unless the ski-type device or reference beam can ride on an adjacent, newly placed lift of HMA. A reference line shall also be used for the first course placed over in-place, recycled material.

Reference lines for the control of horizontal alignment shall be provided by the Contractor subject to the approval of the Engineer.

When a reference line is used for automatic grade control, the Contractor shall furnish and install all pins, brackets, tensioning devices, wire and accessories necessary for satisfactory operation of the automatic control equipment using a taut stringline set to grade for reference.

The transverse slope controller shall be capable of maintaining the screed at the desired slope within plus or minus 0.1 percent. The paver shall be equipped with automatic feeder controls, properly adjusted to maintain a uniform depth of materials ahead of the screed.

b. Manual Operation. Manual operation will be permitted in the construction of irregularly shaped and minor areas, on plant mixed seal courses, or where otherwise directed.

401.03.4 Conditioning of Existing Surfaces. Surfaces of curbs, gutters, vertical faces of existing pavements, and all structures to be in contact with the HMA shall be given a thin, even coating of tack coat. Care shall be taken to avoid the splattering of surfaces which will not be in contact with the HMA.

When a tack coat is required, the type and grade and the application methods shall conform to the applicable provisions of both **SECTION M.03; MATERIALS** and **SECTION 403; ASPHALT EMULSION TACK COAT**, of these Specifications.

401.03.5 Spreading and Finishing. The mixture shall be laid upon an approved cleaned surface, spread and struck off to the grade and elevation established. HMA pavers shall be used to distribute the mixture either over the entire width or over such partial width as may be practicable.

The practices and guidelines for placing HMA as outlined in Asphalt Institute Publication MS-22, "Construction of Hot Mix Asphalt Pavements" shall be adhered to unless otherwise permitted by the Engineer.

Unnecessary walking on the uncompacted HMA mat shall not be allowed.

Before beginning a new lane, the screed shall be heated to the proper operating temperature and any clumps of cold material in the paver hopper shall be removed.

No trucks or other equipment shall be allowed on freshly placed HMA unless specifically permitted by the Engineer.

On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impracticable, the mixture shall be placed as close to its final position as possible. It shall then be spread, raked, and luted by hand tools in a manner which will minimize segregation and result in the required compacted thickness.

Unless otherwise directed by the Engineer, any layer of HMA called for on side streets or driveways must be placed to a distance of at least three feet beyond the gutter line at the same time that layer is being placed on the adjacent project roadway.

a. HMA Designated for "Bridge Decks". When HMA is being placed on a surface which is covered with a waterproofing membrane, the following precautions shall be observed:

1. No traffic other than paving equipment shall be allowed on the membrane.

2. The paver must be moved carefully on and off the membrane. Initial proper adjustment of the paver to the correct depth is very important to prevent tearing the membrane. The Contractor shall be responsible for making any repairs to the membrane or to the HMA overlay necessary to correct damage caused by the paving operation, all at its expense.

3. Any and all tears of the membrane by the paver or trucks shall be repaired immediately to the satisfaction of the Engineer. Vehicle tires shall be clean of any rocks or materials that would puncture the membrane.

4. Truck drivers shall not make quick stops and starts, nor turn the wheels while parked, nor cross the deck at an angle.

401.03.6 Compaction. Immediately after the HMA has been spread, struck off, and surface irregularities adjusted, it shall be thoroughly and uniformly compacted by rolling.

The surface shall be rolled when the mixture is in the proper condition and when rolling does not cause undue displacement, cracking, and shoving.

Two rollers are required for all paving operations that exceed a daily total of 500 tons, except in the case of driveway, sidewalk and bridge deck paving operations. The number, weight and type of roller(s) shall be sufficient to compact the mixture to the required density before it reaches the minimum compaction temperature. Vibratory rollers used for compaction shall be operated in the vibratory mode. All rollers used for compaction shall have a minimum operating weight of ten tons or greater. The use of equipment which results in excessive crushing of the aggregate will not be permitted.

The speed of a roller shall not exceed five miles per hour.

Rollers shall not be parked on HMA. When reversing direction, the action shall be smooth, not abrupt. The drive wheel shall approach the new mix, not the tiller wheel.

When a vibratory roller is used for finish rolling, it shall be used in the static mode. Finish rolling shall continue until all roller marks are eliminated.

The motion of the rollers shall be slow enough at all times to avoid displacement of the hot mixture, and any displacement resulting from reversing the direction of the rollers, or from any other cause, shall be satisfactorily corrected. The wheels of steel-wheel rollers shall be kept moist and clean to prevent adhesion of the fresh material, but an excess of water will not be permitted.

If satisfactory density cannot be obtained in any lift, and if the Engineer determines it to be structurally inadequate and/or incapable of maintaining material integrity, the Contractor shall remove and replace any such area at its own expense.

Any mixture that becomes loose and broken, mixed with dirt, or is in any way defective shall be removed and replaced with fresh hot mixture, which shall then be compacted to conform to the surrounding area. Any area showing an excess or deficiency of PGAB shall be removed and replaced. Said removal and replacement shall be at the Contractor's expense.

For HMA not designated as with "Pay Adjustments" in-place density shall be a minimum of 92% of the theoretical maximum density obtained at the plant and will be determined using a nuclear density gauge or in-place cores.

If a class of HMA is designated as for "Bridge Decks", an oscillatory roller with a minimum operational weight of 8 tons shall be used. For HMA designated as for "Bridge Decks" and with "Pay Adjustments" the pay adjustments will only apply to binder content and air voids.

If a class of HMA is designated as for "Leveling" it shall be placed with a paver. A pneumatic roller with a minimum operational weight of 8 tons shall be used. For HMA designated as for "Leveling" and with "Pay Adjustments" the pay adjustments will only apply to binder content and air voids.

If a class of HMA is designated as for "Patching", "Miscellaneous Work" or "Paved Waterways" it shall be placed by hand. A vibratory plate compactor or roller shall be used. A hand tamper may be used only if requested, and such request is approved by the Engineer.

a) In-Place Density for classes of HMA designated as with "Pay Adjustments"

Compaction density will be measured using cores of in-place pavement. Cores not taken under the direction of and witnessed by the Engineer will not be used for acceptance. The location of all cores will be determined by the Engineer. Each lot and sublot for in-place density cores will be matched as near as practical to each production lot and sublot used at the plant.

All cores shall be extracted after completion of rolling operations and before the paved section is open to traffic. The Engineer will take immediate possession of the cores upon extraction. If the Contractor does not obtain cores before a sublot is open to traffic, no bonus (pay adjustment resulting in more than 0%) will be paid for the sublot but disincentives will still apply. The cores will be retained by the Engineer for 4 weeks after the results are reported to the Contractor.

The Contractor may extract its own cores for QC purposes to monitor in-place density and production quality; such cores will not be used for acceptance.

1. Mat Density

Under the direction and witness by the Engineer, two stratified, randomly selected cores (4" +0"/-0.25" diameter) shall be extracted from the mat by the Contractor for each sublot greater than or equal to 450 tons. One core shall be taken for sublots less than 450 tons. The center of each core used to determine mat density will be at least one foot away from the edge of pavement and any transverse or longitudinal joints or drainage structures.

2. Joint Density

One joint density core shall be extracted for every 3000' or less when a joint is formed. Joint cores shall be extracted so that the center is within two inches of the middle of the sloped portion of a notched-wedge joint or within one inch of the middle of a butt joint.

3. In-Place Density Pay Adjustments

In-place density will be measured and reported as a percent of theoretical maximum density. The pay adjustments from Table 6 will be made for in-place mat density:

Table 6 – Mat Density Pay Adjustments

In-Place Mat Density	Pay Adjustment
95.0% and greater	+2%
94.0% to 94.9%	+1%
93.0% to 93.9%	0%
92.0% to 92.9%	-5%
91.0% to 91.9%	-15%
90.0% to 90.9%	-25%
89.0% to 89.9%	-35%
Below 89.0%	Remove and Replace

The pay adjustments from Table 7 will be made for in-place joint density:

Table 7– Joint Density Pay Adjustments

In-Place Joint Density	Pay Adjustment
93.0% and greater	+2%
92.0% to 92.9%	+1%
91.0% to 91.9%	0%
90.0% to 90.9%	-5%
89.0% to 89.9%	-15%
88.0% to 88.9%	-25%
87.0% to 87.9%	-35%
Below 87.0%	-100%

Note: All density values will be rounded to the nearest 0.1% before applying pay adjustments.

In the event material is required to be removed and replaced, the Engineer will determine the limits of the removal. The required in-place density will be 1% less for the first lift placed on gravel subbase.

4. Calculation of Pay Adjustments for In-Place Density

(i.) For Mat Density:

For each sublot, the bulk specific gravity (G_{mb}) of the mat density core(s) will be averaged and then compared to the corresponding plant theoretical maximum specific gravity (G_{mm}) to calculate the in-place density for each sublot. The average of the sublot densities in a lot will be used to determine the appropriate pay adjustment for that lot. Lot pay adjustments will be applied to the respective quantity of HMA in each lot.

(ii.) For Joint Density:

For joint density pay adjustment purposes, a joint lot will be defined as 10 joint density results. However, if less than five joint density results are remaining after the final full joint lot is formed, they will be added to the previous joint lot. Five or more joint density results remaining after the final full joint lot will constitute a separate joint lot.

Calculation of in-place joint density will be determined using the G_{mb} of joint density cores and the project average plant G_{mm} of the respective mix. The average of the individual joint density results in a joint lot will be used to determine the appropriate pay adjustment for that joint lot. The calculation of material quantity used to construct the joints will be based on the joint core density, the specified thickness, a width of one foot and the length of the joint that each core represents. This quantity will be deducted from the total tonnage.

401.03.7 Joints. Placement of the HMA shall be as continuous as possible. Rollers shall not pass over the unprotected end of a freshly laid mixture unless authorized by the Engineer.

Both longitudinal and transverse joints in successive courses shall be staggered so as not to be one above the other. Longitudinal joints shall be staggered a minimum of 6 inches and shall be arranged so that the longitudinal joint in the top course being constructed shall be at the location of the line dividing the traffic lanes. Any HMA that falls on the cold side of the mat during paving operations shall

be raked onto the hot joint. Care shall be taken to ensure that the material pushed onto the hot side of the joint remains in the joint area and is not broadcast over the pavement.

Unless otherwise permitted by the Engineer, a notched wedge joint shall be used. Longitudinal drop-offs will not be allowed on both sides of a lane. Joints shall be constructed so that the height of the notch is the same as the nominal maximum aggregate size. The width of the sloped portion of the joint shall be at least 6" for each inch of lift thickness if the joint will be exposed to traffic, but in all cases it shall be 12" minimum. Tack coat shall be applied to and shall completely cover the longitudinal notched wedge joint, using either a brush or the tack coat distribution truck. Transverse joints and joints at intersections shall be manually brushed with tack coat, leaving a completely covered face.

401.03.8 Pavement Samples. As directed, the Contractor shall cut samples from the compacted pavement for testing by the Engineer. Samples of the mixture shall be taken for the full depth of the course at the locations directed by the Engineer.

Where samples have been taken, new material shall be placed and compacted to conform to the surrounding area.

401.03.9 Surface Tolerances. At the Engineer's discretion the surface may be tested at selected locations, using an approved 10-foot straightedge furnished by the Contractor. The variation of the surface from the testing edge of the straightedge between any two contacts with the surface shall at no point exceed 1/4-inch. All humps or depressions exceeding the specified tolerance shall be corrected by removing defective work and replacing it with new material as directed.

401.03.10 Thickness Requirements. The thickness of a pavement shall be that as shown on the Plans and shall not vary from the specified thickness by more than that specified in **Subsection 401.04**, below, except as otherwise provided for in resurfacing existing pavements.

401.03.11 Weather Limitations. HMA shall not be placed on any wet surface, or when weather conditions otherwise prevent the proper handling or finishing of the HMA.

For lifts with a target compacted lift thickness less than or equal to 1.5" both the air and surface temperature in the shade shall be 45^{o} F or greater. For lifts with a target compacted lift thickness greater than 1.5" both the air and surface temperature in the shade shall be 40^{o} F or greater. If an approved WMA (warm mix additive) is used both the air and surface temperature in the shade shall be 35^{o} F or greater regardless of lift thickness. No HMA shall be placed on frozen ground.

For projects that do not specify pay adjustments all rolling shall be completed before the temperature of the mat falls below 165^{o} F. The HMA mat (not including WMA modified pavement) shall be at least 265^{o} F when placed.

401.03.12 Cold Weather Paving. If the existing pavement is removed before the winter shutdown, the Contractor shall not close the project for the season until a new HMA layer has been placed and striped with temporary epoxy pavement markings.

401.03.13 Drop-Offs.

a. Longitudinal Drop-Offs. A longitudinal drop-off occurs along the outside edges of pavement and is the difference in elevation between the top of recently placed HMA pavement and the top of existing ground (or pavement).

1. For Posted Speeds of 35 mph or Less. Drop-offs greater than 3 inches but less than 5 inches shall be tapered to a maximum 1-to-1 slope to existing ground or pavement. Drop-offs 5 inches, or greater, shall be tapered to a maximum 4-to-1 horizontal to vertical slope to existing ground or pavement.

2. For Posted Speeds Greater than 35 mph. Longitudinal drop-offs will not be permitted within 2 feet of a travel lane. The first 2 feet adjacent to a travel lane must be at grade with the travel lane. However, should either the sequence of operation required by the Contract or the Contractor's approved sequence of operation result in overnight drop-offs greater than 3 inches occurring between 2 and 6 feet from the edge of a travel lane, then such drop-offs shall be tapered to a 4-to-1 horizontal to vertical slope to existing ground or pavement.

All tapers shall be constructed with HMA conforming to the requirements of this **SECTION 401** of these Specifications.

Longitudinal drop-offs within the roadway cross section will not be allowed except as otherwise detailed on the Plans or as described in a Special Provision.

Longitudinal drop-offs will not be paid for separately, but will be included in the contract unit price for HMA pavements as listed in the Proposal.

b. Transverse Drop-Offs. Transverse drop-offs occur as follows:

Pavement removal. A transverse drop-off occurs when pavement removal operations cease at the end of a working day. The drop-off is the difference in elevation between the bottom of the excavated pavement and the top of the existing pavement.

Pavement overlay. A transverse drop-off occurs when pavement overlay operations cease at the end of a working day. The drop-off is the difference in elevation between the top of the overlay pavement and the top of the existing pavement.

If traffic is allowed across either of these drop-offs during the period prior to the resumption of pavement removal or pavement overlay operations, tapers must be provided as follows:

1. For Posted Speeds of 35 mph or Less. Transverse drop-offs in place at the end of a working day shall be graded at a slope of 2 feet horizontal to 1 inch vertical.

2. For Posted Speeds Greater than 35 mph. Transverse drop-offs in place at the end of a working day shall be graded at a slope of 5 feet horizontal to 1 inch vertical.

All slopes shall be constructed with HMA conforming to the requirements of **SECTION 401** of these Specifications.

The Contractor shall place "BUMP" signs in accordance with the MUTCD (Manual on Uniform Traffic Control Devices) at each drop-off for each direction of traffic.

Prior to the resumption of pavement overlay operations the transition slope shall be removed as follows: The pavement overlay shall be saw cut back approximately 6 inches to expose a fresh, full thickness vertical face. This face shall be brush-painted or pressure sprayed with tack coat, after which the HMA paving may resume.

Transverse drop-offs will not be paid for separately, but will be included in the contract unit prices for HMA pavements as listed in the Proposal.

401.04 METHOD OF MEASUREMENT.

401.04.1 Measurement of HMA Pavement. HMA Pavements will be measured by the number of tons actually placed in accordance with the Plans and/or as directed by the Engineer.

a. Determination of Thickness. The design thickness of each course as well as of the total HMA pavement structure shall be that indicated on the Plans, or as ordered by the Engineer.

Prior to the determination of placed thickness, the roadway shall exhibit acceptable workmanship and all defects shall have been corrected. The placed thickness of HMA pavement will be determined by cutting or coring holes to full depth. For courses with In-Place Density Cores specified, the average thickness of the Density Cores will be used to determine placed thickness.

For courses where In-Place Density Cores are not specified the following requirements apply: For projects with less than 1 paved lane mile, two cores will be taken. For projects with 1 to 2 paved lane miles, four cores will be taken. For projects with greater than 2 paved lane miles, two cores will be taken from each lane mile, except that there will be a minimum of ten cores for the project, all at the discretion of the Engineer.

Cores will be measured in accordance with ASTM D3549; Standard Test Method for Thickness or Height of Compacted HMA Paving Mixture Specimens. The depth measurement will be considered as applying for the full width of the lane. Measurements will be made at random locations determined by the Engineer and all information relative thereto will be recorded in the project records.

For the determination of thickness, a shoulder width of eight feet or greater will be considered to be a separate lane of the roadway. A shoulder width of less than eight feet will be considered part of the adjacent lane. The Contractor shall fill all holes cut or cored in the pavement with a compacted, dense HMA which is acceptable to the Engineer. If required by the Engineer, the Contractor shall maintain and control traffic while the pavement samples are being taken and while the holes are being filled and compacted. Payment will be made for the applicable traffic control item(s).

b. Adjustment of Tonnage Quantity.

The pavement thickness will be considered acceptable if both of the following requirements are met:

(a) The total HMA tonnage delivered and placed does not exceed the tonnage calculated from the approved area measured from the final surface course width by the project length and the pavement thickness specified in the Contract Documents by more than 5 percent.

and,

(b) When Specification Conformity Analysis (Federal Highway Administration Technical Advisory T5080.12; dated June 23, 1989) is applied to the entire roadway or sections thereof as determined by the Engineer, at least 80 percent of the total HMA pavement will have a thickness that meets the minimum pavement thickness. The minimum pavement thickness is that contained in the contract documents minus ½-inch, (e.g., a total pavement thickness of 7 inches will have a minimum pavement thickness requirement of 6.5 inches).

If the first requirement is not met, no payment will be made for all tonnage exceeding 5 percent, unless unusual field conditions are present and documented (e.g., pavement rutting).

If the second requirement indicates that the pavement thickness is deficient, the Contractor with permission of the Engineer shall place a correction course not less than one inch in depth after compaction, provided an acceptable grade and cross section can be achieved. Where an acceptable grade and cross section cannot be achieved through the above means, the Contractor shall reconstruct by cutting back and into the pavement a sufficient distance to permit the placement of an acceptable depth and place new material to achieve the proper depth, cross section and profile. These areas where a corrective course is placed or reconstruction of the pavement is performed, will be measured again as though originally constructed; no compensation will be made to the Contractor for the material removed or removal of materials and disposal thereof or for restoration of affected supporting base or adjacent construction, or for traffic control, adjusting all utility appurtenances in the roadway or for correcting pavement striping. Compensation will be made for the additional pavement correction course accepted in place.

Determination of the quantity to be used for adjusted payment or exclusion for payment will be based on tons per square yard per inch thickness as determined using in-place density cores or 96% of the plant core (AASHTO T245) densities if in-place densities are not available.

Sweeping and cleaning, as included in the items covered by this section, refers to the normal removal of dust, debris, etc. only. Any sweeping and cleaning necessary due to construction being held over for the winter season, in accordance with the approved construction schedule, will be paid for separately.

Work described in **Subsection 401.03.4; Conditioning of Existing Surface**, will be paid for at the contract unit prices for the material used.

Tolerance Limitation. Pavement will be considered acceptable when meeting the specifications. Pavement that is not accepted will be excluded from the tolerance allowance. When delivery tickets are directly collected by the Engineer from each truck prior to placing in the hopper, the delivery tickets may be used in the determination of total tonnage delivered and placed. Delivery tickets not collected directly by the Engineer prior to placing in the hopper will not be used to determine tonnage.

When delivery tickets are not used to determine tonnage, the accepted total tonnage delivered and placed will be calculated according to the following formula: [final surface course width] x [project length] x [specified pavement thickness] x [the average unit weight of all acceptance density cores] =

contract tonnage. If density cores are not required then 96% of the average unit weight of the plant produced acceptance gyratory cores shall be used.

Payment will be made at full contract unit bid prices with pay adjustments for all accepted HMA up to 105% of the contract quantity tonnage. Accepted HMA quantities above 105% and up to 110% of the contract quantity tonnage will be paid at 50% of the contract unit bid price with the resultant adjusted price further modified by additional pay adjustments as applicable according to the following formula: Pay adjustments will apply to 50% of the contract unit bid price for quantities above 105% and up to 110%.

401.05 BASIS OF PAYMENT. The accepted quantity of the HMA will be paid for at its respective contract unit price per ton as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials and equipment, and for all incidentals required to finish the work, complete and accepted by the Engineer.

Pay adjustments for binder content, air voids and in-place density will be added together to determine a final pay adjustment for both the mat and the joint. If more than one pay adjustment is negative then only the most negative adjustment will be added to the remaining non-negative adjustments to determine the final pay adjustment. Pay adjustments will be applied to the unit bid price for the applicable item code.

Remove **Section 410; Temporary Patching Material Potholes and Trenches,** pages 4-39 and 4-40 of the RI Standard Specifications for Road and Bridge Construction in its entirety and replace it with the following.

SECTION 410

TEMPORARY PATCHING OF POTHOLES AND TRENCHES

410.01 DESCRIPTION. This work consists of repairing roadway potholes and patching utility and drainage trenches during the construction of the roadway at locations indicated on the Plans and/or as directed by the Engineer and/or as necessary to maintain a safe and passable transportation facility, all in accordance with applicable specifications.

410.02 MATERIALS. The temporary patching material shall conform to the requirements for Class 4.75 or Class 9.5 hot mix asphalt as required, or High Performance Cold Patching Material, as set forth in **Subsection M.03.04** of these Specifications.

410.03 CONSTRUCTION METHODS.

410.03.1 Potholes. The Contractor shall repair all potholes within the project limits, regardless of the cause for, or tenure of the pothole, commencing ten calendar days following the official notice to proceed and thereafter maintain the roadway within the project limits in a safe and passable condition.

Repair shall consist of placing asphalt patching material by hand in up to 2-inch lifts leaving the repair flush with the existing roadway pavement when complete. The pothole shall be free of loose asphalt, debris and excess moisture. The compaction shall be done using a vibratory plate compactor or other appropriate equipment.

410.03.2 Trenches. The Contractor shall repair all trenches within the project limits.

Repair shall consist of placing asphalt patching material in a workmanlike manner. The existing pavement shall be neatly cut on both sides. The gravel backfill shall be compacted to the required density and the subgrade left free of loose asphalt, debris and excess moisture. The bituminous patch material shall be placed in a properly compacted 2-inch lift unless otherwise detailed on the Plans. When completed, the patch shall be left flush with the existing roadway pavement.

410.03.3 Damage Claims. Failure to maintain the roadway as required by this Section will result in the Contractor being held liable for any and all damage claims in accordance with **Subsection 107.13; Responsibility for Damage Claims.**

410.04 METHOD OF MEASUREMENT. Temporary patching of potholes as specified in this Section will not be measured by a single unit of measurement but instead will be documented on a Force Account basis as set forth below in **Subsection 410.05.1**.

410.04.1 Trenches. Temporary patching of trenches will be measured by the number of tons of such material actually placed in accordance with the Plans and/or as directed by the Engineer

410.05 BASIS OF PAYMENT.

410.05.1 Potholes. Temporary patching of potholes will be paid for on a Force Account basis as set forth in **Para. a.4** of **Subsection 109.04; Differing Site Conditions, Changes, Extra Work and Force Account Work**, of these Specifications.

410.05.2 Trenches. Temporary patching of trenches will be paid for at the contract unit price per ton as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, and equipment and all incidentals required to finish the work, complete and accepted by the Engineer.

Add the following new **Section 414; Warm Mix Additive** to the RI Standard Specifications for Road and Bridge Construction.

SECTION 414

WARM MIX ADDITIVE

414.01 DESCRIPTION. This work consists of incorporating a WMA (Warm Mix Additive) in HMA (Hot Mix Asphalt).

414.02 MATERIALS. One unit of WMA shall be added to each ton of HMA. All WMA shall be selected from the RIDOT Approved Materials List and shall be added at a dosage rate recommended by the manufacturer.

414.03 CONSTRUCTION METHODS. If HMA is designated as "with WMA", the Contractor shall use a WMA. If HMA is not designated as "with WMA", the Contractor may request to use a WMA at his own discretion and expense. Additionally, the Engineer may direct the Contractor to use a WMA. If a WMA is used it shall be for an entire day's production for that class of HMA.

414.04 METHOD OF MEASUREMENT. WMA will be measured by the number of units actually used in accordance with the specifications and/or as directed by the Engineer.

414.05 BASIS OF PAYMENT The accepted quantity of the WMA will be paid for at its respective contract unit price per each as listed in the Proposal.

Remove **Subsections 601.03.7(b) through 601.03.7(h)**; pages 6-17 through 6-21 of the RI Standard Specifications for Road and Bridge Construction in their entirety and replace with the following:

601.03.7

TESTING OF CONCRETE

b. Engineer's Acceptance Sampling, Testing and Inspection. The Engineer is responsible for sampling, testing, and inspection for acceptance, except for furnishing of necessary materials, which shall be the Contractor's responsibility as directed by the Engineer and at no additional cost to the State. Acceptance is based on the Engineer's inspection of the construction, monitoring of the Contractor's quality control program, and the acceptance test results.

The Contractor shall afford the Engineer all reasonable access without charge.

Samples of fresh concrete for testing will be taken after all concrete retempering is performed. When sampling from within the forms is impractical, samples will be taken at the nearest accessible point in the conveyance system prior to placement into the forms.

Acceptance sampling and testing will meet the requirements of the Contract and the "Master Schedule for the Preparation of a Project Schedule for Sampling, Testing, and Certification of Materials."

Whenever random samples do not meet specifications, subsequent continuous samples will be taken from each truck batched until field test results indicate that specifications are satisfied, after which time random sampling will resume.

Compressive strength test specimens will be standard 4"x 8" cylinders for all placements unless otherwise modified by the Engineer.

c. Engineer's Acceptance Plan.

The following is the acceptance plan necessary to obtain samples, perform tests and provide inspection of the work. The terms used in this acceptance plan are defined as follows:

1. **Placement.** For a given class of concrete, the portions of a concrete structure constructed during one continuous concrete operation.

2. **Acceptance Plan**. The method of taking measurements of samples for the purpose of determining the acceptability of a Placement of material or construction. Acceptance plans include random sampling plans.

3. **Random Sample**. A sample chosen in such a manner that each increment in the Lot has an equal probability of being selected. The Engineer reserves the right to take more samples, in addition to those samples taken in accordance with the random sampling plan.

4. **Acceptance**. As defined in Table 5 - Placement Acceptance Schedule.

5. Rejection. When used in this context "rejection" shall mean remove, dispose and replace at the Contractor's expense, or at the discretion of the Engineer "rejection" will mean acceptance at a lower price determined by Pay Factors, as specified herein.

6. Lot. An isolated quantity of material from a single source or a measured amount of construction produced by the same process. For Placements less than 750 cubic yards the Lot shall be 150 cubic yards or less. For Placements of 750 cubic yards or greater the Lot shall be 250 cubic yards or less.

Lots will be determined as follows:

a) The total cubic yards for the Placement will be divided by 150 for Placements less than 750 cubic yards and 250 for Placements greater than or equal to 750 cubic yards.

b) The result will then be rounded up to the next whole number. This number is the number of Lots in the Placement.

c) The total cubic yards for the Placement in (a) will be divided by the number in (b) to determine Lot size.

d) Each Lot size will be adjusted by rounding to the nearest 10 CY (or other number representing one truck load), and this adjusted Lot size will be used to determine the number of trucks in the Lot.

e) For purposes of the acceptance plan the total cubic yards of concrete placed for all the Lots will be the Placement volume.

7. Sublots. Equal divisions or portions of a Lot as defined herein.

The Sublot size for each Lot will be calculated by dividing each Lot into thirds rounded to the nearest truck.

a) Cylinders will be cast for each Placement less than or equal to 150 cubic yards of concrete delivered for each class of concrete in accordance with the following:

1 truck = 4 cylinders from the 1 truck
(6 cylinders for Class MC)

2 trucks = 4 cylinders from 1 randomly selected truck
(6 cylinders from 1 randomly selected truck for Class MC)

3 trucks = 2 cylinders from each of 2 randomly selected trucks
(3 cylinders from each of 2 randomly selected trucks for Class MC)

4 thru 10 trucks = 2 cylinders from 1 randomly selected truck from the first half of the Placement and 2 cylinders from 1 randomly selected truck from the second half of the Placement.
(3 cylinders from 1 randomly selected truck from the first half of the Placement and 3 cylinders from 1 randomly selected truck from the second half of the Placement for Class MC).

11 thru 15 trucks = 2 cylinders from 1 randomly selected truck from the first third of the Placement, 2 cylinders from 1 randomly selected truck from the second third of the Placement and 2 cylinders from 1 randomly selected truck from the final third of the Placement.

b) Cylinders will be cast for each Placement greater than 150 cubic yards and less than 750 cubic yards of concrete delivered for each class of concrete in accordance with the following:

2 cylinders from 1 randomly selected truck from the first third of the Lot, 2 cylinders from 1 randomly selected truck from the second third of the Lot and 2 cylinders from 1 randomly selected truck from the final third of the Lot.

c) Cylinders will be cast for each Placement greater than or equal to 750 cubic yards of concrete delivered for each class of concrete in accordance with the following:

2 cylinders from 1 randomly selected truck from the first third of the Lot, 2 cylinders from 1 randomly selected truck from the second third of the Lot and 2 cylinders from 1 randomly selected truck from the final third of the Lot.

Sidewalk placements will have a minimum of one set of four cylinders taken from one randomly selected truck per project per day.

d. Placement Acceptance Compressive Strength Evaluation. Acceptance for compressive strength will be evaluated relative to compliance with the minimum 28 or 56 day compressive strength (f'c) specified herein for each class of concrete produced in accordance with TABLE 5 - Placement Acceptance Schedule. Acceptance for Class MC will be based on 56-day compressive strength test.

Three cylinders randomly selected from each set of 4 or 6 cylinders, as determined under "Sublots", will be tested for either 28-day or 56-day compressive strengths.

Case A: Single Lot Placement.

The average 28 or 56 day compressive strength of 3 cylinders selected from a set of 4 or 6 cylinders and the Range, the difference between the largest and the smallest test result, will be used to calculate the acceptance of the Placement. The following formulas will be used to calculate the Placement Acceptance Test Result (PATR). The Engineer reserves the right to use Formula – B for any Lot size when more than one set of 3 cylinders are tested.

Formula - A

$$PATR = \overline{X} = \frac{X1+X2+X3}{3}$$

$$RANGE\ (R) = X_{(largest)} - X_{(smallest)}$$

Symbols

X= individual test value which is the 28 or 56 day compressive strength of each cylinder tested.

$\overline{X}$= the mean (average) 28 or 56 day compressive strength of a set of 3 cylinders.

R= (Range), the difference between the largest and smallest 28 or 56 day compressive strength test result.

PATR= Placement acceptance test result.

Case B: Multiple Lot Placements.

For multiple Lot placements 3 cylinders from each set of 6 cylinders from each Lot will be tested for 28 or 56 day compressive strength. The mean value of the sum of the average compressive strengths and the mean value of the sum of the Ranges will be used to calculate the acceptance of the Placement. The following formula will be used to calculate the Placement Acceptance Test Result (PATR).

Formula – B

$$PATR = \bar{\bar{X}} = \frac{\bar{X}1 + \bar{X}2 + \ldots + \bar{X}_n}{n}$$

$$\bar{R} = \frac{R1 + R2 + \ldots + Rn}{n}$$

Symbols

$\bar{X}$ = the mean (average) 28 or 56 day compressive strength of a set of 3 cylinders for each Lot.

$\bar{\bar{X}}$ = the mean (average) of the sum of the average 28 or 56 day compressive strength test result of each Lot.

$\bar{R}$ = the average of the sum of the Ranges (R) for each Lot.

n = number of sets.

Concrete will be evaluated for acceptance in accordance with Table 5 - Placement Acceptance Schedule, on the basis of the calculated Placement Acceptance Test Results (PATR).

Table 5
Placement Acceptance Schedule

Placement Acceptance Test Result (PATR) ($\bar{X}$ or $\bar{\bar{X}}$)	**Pay Factor** (PPF)
Not less than f ' c + 0.21 R (or $\bar{R}$)	1.00
Not less than f ' c + 0.04 R (or $\bar{R}$)	0.95
Not less than f ' c - 0.10 R (or $\bar{R}$)	0.70
For less than f ' c - 0.10 R (or $\bar{R}$)	0.50

1. f 'c is the specified 28-or 56 day compressive strength.

2. Range R (or $\bar{R}$) is the difference between the results of the largest and smallest Lot acceptance test results.

Acceptance of the Placement at the 0.95 Placement Pay Factor (PPF) in lieu of remove, dispose and replacement of the Placement will be at the request of the Contractor and approval by the Engineer.

Acceptance at the 0.70 or 0.50 Placement Pay Factor (PPF) in lieu of remove, dispose and replacement will be as determined by the Engineer on the basis of the effect of the non-conforming Lot on the structural and durability integrity of the concrete structure.

The Contractor may elect to remove and dispose any non-conforming material and replace it with new material to avoid a PPF of less than 1.00. Any such new material will be sampled, tested, and evaluated for acceptance in accordance with the applicable requirements of this **SECTION 601**.

The Engineer may reject any quantity of material which appears to be non-conforming based on visual inspection or test results. Such rejected material shall not be used in the work and the results of the tests run on the rejected material will not be included in the calculation of the Placement Acceptance Test Results.

Remove **Subsection 601.05; Basis of Payment,** page 6-25 of the RI Standard Specifications for Road and Bridge Construction in its entirety and replace it with the following.

601

PORTLAND CEMENT CONCRETE

601.05 BASIS OF PAYMENT. "Portland Cement Concrete," complete in place and fully accepted, will be paid for as provided in these Specifications. These payments constitute full compensation for furnishing all labor, materials, equipment, tools, and incidentals to produce, place, and protect the concrete as herein specified, in addition to any requirements in the Specifications for the particular use, except that a reduction in payment will be made for each Placement of Concrete not fully accepted. This reduction in payment for Placement will be based on the following:

Case 1: For concrete for which a unit price is provided in the Proposal:

Unit price reduction = (1.00-PPF) x the unit bid price in the Proposal

Case 2: For concrete which is paid for as part of a lump sum item or lump sum items as listed in the Proposal:

1. (1.00-PPF) x the price of the various items of concrete per cubic yard as provided in the approved Contractor's Lump Sum Breakdown

PPF is the pay factor determined in **Subsection 601.03.7(d.).**

Remove **SECTION 607, MASS CONCRETE;** pages AC14–4 through AC14-14 in the August 2013 Compilation of Approved Specifications in its entirety and replace it with the following.

SECTION 607

MASS CONCRETE

607.01 DESCRIPTION. This specification covers the requirements for concrete used in mass concrete elements. Concrete proportioned for mass concrete applications shall conform to the applicable requirements of **PARTS 600** and **800** of these specifications, together with the additional provisions set forth below.

607.01.1 DEFINITIONS. Mass Concrete is defined as any elements so specified on the Plans and any other concrete pour where the ratio of the total volume to the surface area of the element equals or exceeds 0.6 and has a minimum dimension of 3 feet in any of the three planes. Calculation of the ratio shall be performed based on all dimensions measured in feet.

Requirements for mass concrete construction include laboratory testing, thermal modeling, temperature monitoring, and providing concrete temperature control before, during, and after placement. All testing shall be performed at a laboratory with recognized AASHTO accreditations for performing the required tests (AASHTO T22, AASHTO T23, AASHTO T121, AASHTO T152, ASTM C1064, ASTM C1074), with the provision that no exception is taken by the Engineer with the Contractor's choice of laboratory.

The peak temperature is defined as the average of the values measured at any given time by the two temperature sensors placed at the location of the highest temperature as determined by the thermal model for the structural element. The highest acceptable peak temperature is 155°F.

The differential temperature is defined as the difference in values measured at any given time between the temperature sensor(s) in any given location (or the average, if two sensors placed in the location) in the structural element and the peak temperature as defined above. The highest acceptable differential temperature until the completion of temperature control is 35°F.

The performance-based differential temperature is defined as a limit that changes as the concrete gains strength, determined as a function of the established maturity curve for the mix. The benefit of this method is a potential acceleration of the production schedule over the use of a fixed limit. This option may be considered by the Engineer, with the proper submission of an implementation plan for the process as described herein, after the contractor has demonstrated compliance with the specifications of the concrete mix during batching, placement and curing.

607.02 MATERIALS AND EQUIPMENT.

607.02.1. CONCRETE. The concrete shall meet the applicable material requirements of **SECTION 808** and **SECTION 601**. Unless specified in the contract documents, calcium nitrite based corrosion inhibitor shall not be used in Mass Concrete mixtures. Any proposed mixture adjustment that meets the requirement in **SECTION 601** for a new approval of the mix design will also require a new approval of

the mass concrete temperature control plans per this specification.

607.02.2 TEMPERATURE AND MATURITY RECORDING. Primary temperature measuring loggers shall be designed specifically for determining the maturity of concrete in accordance with ASTM C1074. They shall operate in the range of 0°F to 212°F to an accuracy of +/- 1°F and internally record the time and temperature at a minimum of 1 hour intervals for a minimum of 90 days. Each logger shall have a unique serial number and shall upon download of the information using the compatible reader or other appropriate data connection, produce a secure (unalterable) Windows PC-readable file that identifies the logger by its serial number and the start date. Software shall be provided to develop maturity curves to predict strength and display the temperature versus time data for all of the loggers in a given placement.

The data leads shall be sized to reach from the logger's installed location to an accessible site where a handheld reader can be employed. A data cable that can connect the loggers to a notebook computer or other standard mobile device will be considered equivalent to a handheld reader, providing a Windows PC-readable file can be created that can be transferred to a Windows PC. The Contractor shall provide a reader and necessary software for the exclusive use of the Engineer. The reader and software provided for the Engineer shall become the property of the State at the completion of the project.

The loggers selected by the Contractor shall have the capability to use battery operated Wireless Remote Boxes for the downloading of data. The transmission range of the system shall be sufficient to provide a reliable connection to both the Contractor’s and Engineer’s field offices. A Windows PC-Compatible Wireless System Radio Base Station shall be provided and capable of downloading the data file as described above. The Wireless System Radio Base Station shall be maintained by the Contractor for monitoring the mass concrete placement. An additional Wireless System Radio Base Station shall also be provided for the Engineer’s field office. The additional device and associated software provided for the Engineer shall become the property of the State at the completion of the project.

The requirement for a wireless communications system may be waived by the Engineer, if the Engineer determines that access to the placement does not warrant it.

The Contractor shall provide the Engineer recording equipment that will allow intermediate downloading of measurements to a computer without restarting the logger. The recording equipment provided for the Engineer shall become the property of the State at the completion of the project. An automatic temperature monitoring system shall be provided with email, phone, or text message alarm capability to notify the Contractor when temperature control limits are about to be exceeded.

The Contractor must submit technical literature on the complete maturity logger system, including the loggers, handheld reader, wireless system, software and any other components to the Engineer for approval prior to the first mass concrete placement. This shall include manufacturer contact information for the responsible technical representative and product performance history showing at least one year of successful use of the complete system on a minimum of three projects with mass concrete placements comparable to those within the scope of this project. Contact information shall be provided for the project owners. No mass concrete placements shall proceed until approval of the maturity logger system has been given in writing by the Engineer.

607.03 SUBMITTALS.

607.03.1 Mass Concrete Temperature Control Plans. As part of the submittals, the Contractor shall submit a “Mass Concrete General Temperature Control Plan" for approval prior to the first mass concrete placement and shall be stamped by a Rhode Island Registered Professional Engineer. This shall show the general procedures proposed for temperature control. A "Mass Concrete Specific Temperature Control Plan" shall be prepared for each unique placement and shall be based on the general plan. Each specific temperature control plan shall provide guidance for the Contractor, developed based on a concrete hydration temperature model, to indicate when the peak and differential temperatures might exceed the specification limits. The guidance shall provide specific concrete placement temperature restrictions based on anticipated ambient temperatures and other environmental factors, passive and active cooling, and insulation practices that could produce peak or differential temperatures that require remedial action. Guidance shall also be provided on appropriate remedial actions to be taken when concrete temperatures approach specification limits. At a minimum, these guidelines shall take effect when the concrete peak temperature reaches 3°F below the specification limit of 155°F and when the differential temperature reaches 2°F below the specification limit of 35°F or the temperature value at the specified maturity, for the variable differential limit, (if approved). Each specific plan shall be submitted for approval prior to the placement and shall be stamped by a Rhode Island Registered Professional Engineer. Costs related to the development of Mass Concrete Temperature Control Plans shall be considered incidental to the project, and will not be paid for separately.

Approval of any Mass Concrete Temperature Control Plan by the Engineer will not relieve the Contractor of his responsibility to maintain concrete temperatures within specification limits.

a. General Mass Concrete Temperature Control Plan. The General Mass Concrete Temperature Control Plan shall include the following:

1. Concrete mixture proportions, indicating aggregate sources and physical properties, cementitious material sources, and admixture product names and doses for each concrete mixture. The Class MC concrete mixture design and prequalification test results shall be submitted for approval separately.

2. Anticipated mass concrete placement schedule, including proposed concrete mixture adjustments for the full range of conditions that may occur during placement and curing operations.

3. Concrete temperature rise for each mixture shall be tested directly in an adiabatic concrete calorimeter cast from laboratory trial batches using the same material sources and proportions as intended for use on the project.

4. Concrete compressive strength development in standard moist curing environment (73.5 ± 3.5 deg F) at 3, 7, 14, 28, and 56 days for each mixture, based on the average of three 6” x 12” cylinders for each age. Cylinders shall be cured and tested per AASHTO T22. Cast a temperature sensor in the center of two additional cylinders and cure these cylinders alongside those used for compressive strength. Record the average temperatures of the cylinders hourly. Report the compressive strength and maturity for each specimen at each test age and the average values.

5. Calculate and report the concrete strength development-maturity equation for each mixture from the standard cured strength results as described in ASTM C 1074 "Estimating Concrete Strength by the Maturity Method".

6. Demonstration Mock-up(s) shall be performed at least 60 days prior to the first scheduled Mass Concrete Placement. The Contractor shall cast at least one mock-up to verify that the concrete

thermal properties and temperature control procedures required for the Mass Concrete General Temperature Control Plan are adequate to meet the specification limits. The mock-up(s) shall use the same concrete mixture proportions and materials, form materials, curing materials, and monitoring devices defined in the General Temperature Control Plan, and shall use the same batching and placing operation to be used for the project. The mock-up shall be a cube or other element measuring 4 ft or more in the least dimension. Temperature monitoring of the mock-up shall be as specified in the General Mass Concrete Temperature Control Plan and shall continue for at least seven (7) days. As a minimum, the demonstration mock-up shall be insulated with R-20 insulation on all sides. If alternate insulation, cooling, or curing options are proposed, a separate demonstration mock-up cube shall be cast and instrumented for each alternate. The engineer responsible for the design of the temperature control plan shall be present at the placement for each mock-up.

Sensor placement:

a. Two sensors shall be located at the center of the mock-up. The average of these two shall be used.

b. Two sensors shall be located within one inch from the top surface located directly above the center of mass sensors. The average of these two shall be used.

c. Two sensors shall be located within one inch from the center of a vertical face. The average of these two shall be used.

d. Two sensors shall be located in an upper corner of the cube. The average of these two shall be used.

e. One sensor shall be used to record the ambient temperature. This sensor shall be placed at approximately ten (10) feet from the placement, in a shaded area.

Note: A 5°F or greater variation between sensors of a paired set, or erratic variations or outright failure of a sensor shall be brought to the attention of the Engineer immediately upon discovery of the problem. At the time of the notification, the Contactor shall provide the Engineer with a course of corrective action for approval. If the approved corrective action requires that the data from one sensor in a pair no longer be used, the other functioning sensor shall be used solely for the peak and maximum differential temperature measurements.

From the concrete batched for the mock-up, the Contractor shall have tests conducted for air content (AASHTO T152), placement temperature (ASTM C1064, unit weight (AASHTO T121) and fabricate cylinders (per AASHTO T23) from the same concrete by an ACI Certified Concrete Field Technician Level I. The cylinders shall be tested for compression strength by an AASHTO Accredited independent concrete testing laboratory (AASHTO T22) at 3,7, 14, 28, and 56 days. The Contractor shall coordinate the mock-up with the Engineer, and shall provide the State at least one week advance notice of the casting date. The Engineer shall be provided the opportunity to witness the placement and functioning of temperature recording sensors prior to casting, and may perform concrete property tests on companion samples selected by the Engineer.

If a mix design has been approved for mass concrete placement prior to the scheduled first placement for this project and the testing conforms to these standards, the Engineer may waive the requirement of **Subsection 607.03.1(a.1)** through **607.03.1(a.6)**. However, any requirements for

testing/analysis added after the aforementioned mix design was approved shall still be performed, with the exception that mix designs previously approved using data derived from semi-adiabatic testing will not require re-testing per the above requirements. If the approved mix design has already had a mock-up performed previously and the criteria matches that for the applicable temperature control plan, the Engineer may accept the results of the previous mock-up instead of running a new one.

A letter report documenting the concrete properties and temperatures developed in the mock-up compared against the thermal analysis contained in the General Mass Concrete General Temperature Control Plan models shall be submitted as part of the General Temperature Control Plan. Any revisions/corrections required to the General Mass Concrete Temperature Control Plan for differing ambient conditions shall be outlined in the letter report. Strength results may be submitted separately.

If the project involves four or less unique mass concrete placement designs, the Engineer may waive the requirement for a General Mass Concrete Temperature Control Plan. If waived, the Specific Mass Concrete Temperature Control Plans shall meet all of the requirements listed above.

b. Specific Mass Concrete Temperature Control Plans. Each Specific Concrete Temperature Control Plan shall include the following:

1. Form and form liner R-value and anticipated time of form removal.

2. Insulating material(s) R-value and anticipated periods of use.

3. Curing procedure and duration.

4. Thermal modeling analysis for typical placement scenarios shall be provided. The analysis shall incorporate, but not be limited to: A range of anticipated ambient placement temperatures, anticipated water temperatures for active cooling, effects of water temperature for placements in water, effects of convection cooling in locations where high winds may be a factor, anticipated concrete placement temperatures, assumed R-values for concrete forms and insulation, and shall calculate maximum core and surface temperatures vs. time after placement. The impact of planned construction activities, such as form removal, shall be included in the analysis. Concrete strength at form removal shall be estimated from the maturity relationship using the lowest calculated maturity value shown by the sensors placed within the concrete.

5. Drawings identifying temperature monitoring locations for each placement, and product data for all sensors and recording instrumentation shall be provided. With the exception of the ambient sensor, the sensors shall be installed in pairs for the redundancy. The minimum number of automated temperature monitoring locations shall be nine (9) per element for placements less than 500 yd^3, and seventeen (17) for placements 500 yd^3 or larger. Minimum sensor locations are noted below. Each of the sensors in a pair shall be placed in separate locations, no less than 6" and no more than 18" apart: The relative locations shall be as shown for the mock-ups.

    a. Two sensors shall be placed in the center of thermal mass of the placement, where the peak temperature will occur. This location shall be based on the isocurves developed for the model, with the approval of the Engineer. The average of the two will be used to determine the peak temperature at any given time and to measure the maximum temperature differential in the placement based on the difference between the peak temperature and each sensor location at any given time. The average of the two sensors

shall be used.

b. Two sensors shall be placed at the location as determined by isocurves developed for the model that shows the point where the lowest temperature is predicted during temperature control. The average of the two sensors shall be used.

c. Two sensors shall be located within one inch from the top surface located directly above the center of thermal mass sensors. This location may be adjusted, based on the isocurves developed for the model, with the approval of the Engineer. The average of the two sensors shall be used.

d. Two sensors shall be located within one inch from the center of vertical formed surfaces at mid-height. This location may be adjusted, based on the isocurves developed for the model, with the approval of the Engineer. The average of the two sensors shall be used.

e. One sensor shall be used to record the ambient temperature. This sensor shall be placed at approximately ten (10) feet from the placement, in a shaded area.

f. The Contractor shall also provide up to four (4) additional sensor pairs to be located at the discretion of the Engineer.

g. Use similar sensor distribution for placements greater than 500 yd^3.

Note: A 5°F or greater variation between sensors of a paired set, or erratic variations or outright failure of a sensor shall be brought to the attention of the Engineer immediately upon discovery of the problem. At the time of the notification, the Contactor shall provide the Engineer with a course of corrective action for approval. If the approved corrective action requires that the data from one sensor in a pair no longer be used, the other functioning sensor shall be used solely for the peak and maximum differential temperature measurements.

Following a mass concrete pour, the Engineer may require the Contractor to perform thermal modeling analysis of the placement using actual concrete and ambient temperatures to evaluate the effects of construction practices such as, but not limited to, form removal or curing. If required, this shall be performed at no additional cost to the State.

Procedures for achieving temperature restrictions including contingencies for severe weather events shall be provided. Procedures may incorporate either active (cooling pipes) or passive control methods (insulation, tenting, venting, etc.) or both. The Temperature Control Plan shall show the expected duration of all temperature control measures for each model condition provided.

If cooling pipes are proposed, submit detailed description of the system describing the layout and size of pipes, anticipated coolant flow rate, temperature of the raw coolant source, pump size, flow and recirculation control equipment, instrumentation, coolant temperature control procedure, and contingency plans.

607.03.2 Performance-Based Variable Temperature Differential Limit. After the Contractor has established, to the satisfaction of the Engineer, that proper control can be maintained of the concrete mix properties, including curing temperatures, the Contractor shall have the option of submitting a plan to use a performance-based criteria for a variable differential limit, based on the concrete strength as determined by the maturity at any given time. This will supersede the 35°F limit. Failure to maintain proper

temperature control under this plan will result in reversion to the 35°F limit for subsequent placements until such time that the Contractor demonstrates to the Engineer that causes for the loss of control have been identified and corrected. Temperature control will be considered to have failed if one of the following conditions occurs:

- The differential exceeds the variable value by more than 3°F at any time during the first 40 hours after placement.
- The differential exceeds the variable value by more than 5°F at any time after the first 40 hours after placement during temperature control.
- The differential exceeds the variable value by 2°F or more for any period of 8 hours or more at any time during temperature control.
- Cracking of the placement determined to be the result of thermal issues will also be considered to be failure of the temperature control and will result in reversion to the 35°F limit, as well as triggering the provisions specified in **Subsection 607.05.4**.

Plan Submission Requirements. The Contractor's written implementation plan shall include complete back-up data such as, but not limited to, listing of all assumptions used in the analysis, published reference documents, coefficient of the thermal expansion for the mix being placed, tensile strength development versus maturity equations for the mix being placed, elastic modulus versus maturity equations for the mix being placed, example implementation of the method using a predicted thermal gradient analysis and complete test data justifying the prediction equations for the proposed mixture. Each placement shall also include a specific plan with an assumed restraint factor, consideration of the placement geometry and other factors that can affect the differential limit. The other factors shall include, but not be limited to, anticipated concrete placement temperature, ambient temperatures, cooling water temperature (if active cooling is used), convection effects from wind and design elements of the temperature control plan.

For acceptable demonstration of the submission of an implementation plan, the Contractor may use a mass concrete pour defined and conducted using the 35°F differential limit. The gradients predicted in the thermal model for the performance-based temperature limit shall match the actual temperatures to the satisfaction of the Engineer. It shall have as a minimum a set of at least eleven temperature/maturity sensors. Locate sensors as follows:

1. At the location of the maximum temperature, at least one sensor shall be placed as defined in **Subsection 607.03.1(b.5.a)**;
2. Near the formed surface, at least one sensor shall be placed as defined in **Subsection 607.03.1(b.5.b)**
3. Near the top surface\, at least one sensor shall be placed as defined in **Subsection 607.03.1(b.5.c)**;
4. A minimum of two equally spaced between the location of the maximum temperature and top surface sensor in an approximate straight line configuration;
5. A minimum of two equally spaced between the location of the maximum temperature and formed surface sensor in an approximate straight line configuration;
6. At the location of the minimum temperature, at least one sensor shall be placed as defined in **Subsection 607.03.1(b.5.d)**;
7. A minimum of two equally spaced between the location of the maximum temperature and the location of the minimum temperature, in an approximate straight line configuration;
8. One sensor shall be used to record the ambient temperature remote from the placement, as defined in **Subsection 607.03.1(b.5.e)**.

For items 1, 2, 3 and 6, the sensors may be the same as those used for the actual temperature control of the placement as specified in **Subsection 607.03.1(b).** While redundant sensors are not required, failure at any of the required locations without a backup will invalidate the results.

The performance-based temperature limit plan shall be submitted for approval prior to the first placement for which it is proposed to be used and shall be stamped by a Rhode Island Registered Professional Engineer. Should the plan be approved by the Engineer, this will become the standard sensor distribution for as long as this plan is in effect and shall be used to verify the accuracy of the performance-based temperature limit plan thermal model for each placement. The plan shall show a relationship between the maturity and the appropriate maximum acceptable temperature differential that will prevent cracking of the concrete. The relationship shall be shown in tabular form, at intervals of one (1)°F for the first forty (40) hours after placement and two (2)°F for more than forty (40) hours after placement. to a minimum of fourteen (14) days. The maturity value used to determine the appropriate differential at any given time shall be the lowest measured within the placement.

607.04 CONSTRUCTION METHODS. Applicable construction requirements for **SECTION 808; CAST-IN-PLACE STRUCTURE CONCRETE MASONRY** and **SECTION 601; PORTLAND CEMENT CONCRETE** shall apply, with the following additions:

607.05 TEMPERATURE CONTROL REQUIREMENTS.

607.05.1 Temperature Control. Mass concrete temperature control shall be monitored by maturity loggers cast into the concrete, as described in **Subsection 607.03.1**. Use of low heat concrete mixtures, pre-cooling of the concrete, insulated curing blankets, insulated forms, cooling pipes, and other measures may be necessary to satisfy the temperature control requirements.

The Contractor shall notify the Engineer immediately when temperature control limits are exceeded.

Complete concrete temperature records for each placement including the secure files generated by the automated temperature sensors shall be provided to the Engineer. The Engineer shall be provided unobstructed access to temperature sensors at any time to verify compliance with temperature control criteria.

a. When forms are placed in water, the forms and insulation shall be waterproof or otherwise protected against water absorption. The required combined form and insulation R-Value shall be determined through thermal analysis prior to placement using forecasted temperatures to meet the requirements to maintain the maximum peak and differential temperatures within the limits defined in its specification.

b. The temperature of the concrete at placement must not exceed 65°F for cold weather placements, nor 85°F for hot weather placements, unless active temperature control precautions are employed. All active temperature control piping shall be non-metallic and shall be filled with a non-shrink grout on the RIDOT Approved Products List upon completion of cooling operations. The temperature of the concrete at placement shall be within the acceptable range of values shown in the temperature control plan for the structural element.

c. Temperature sensors shall be maturity loggers as described in **Subsection 607.02.2**. The logger shall be programmed with the appropriate datum temperature.

d. Wiring for loggers that must be cast into the concrete shall be secured to reinforcing or otherwise protected to prevent damage during concrete placement. The method of protection of the wires cast into the concrete shall be approved by the Engineer and shall use methods satisfactory to the Engineer. Wiring for loggers shall be clearly labeled to identify the location within the form at both ends before being placed into the form. Ambient temperature sensors shall be located no closer than 10 feet from the Mass Concrete Placement and shall be placed as to provide an accurate measurement of the environmental condition. Wire runs outside of concrete shall be encased in conduit where necessary to prevent damage during subsequent construction operations.

e. The Contractor shall not perform installation and verification checks for operation of any loggers unless the Engineer is present. The Contractor shall provide as-built versions of the temperature control plans showing the location of the loggers as identified by the unique serial numbers. Upon completion of monitoring all visible wires shall be removed from the concrete and any conduit penetrations filled with a non-shrink grout on the RIDOT Approved Product List.

f. Each logger shall be programmed with notes identifying the placement and relative location within the placement. Loggers shall be secured into position and function shall be verified at least one day prior to concrete placement. Temperature recording for each placement shall start no less than 2 hours prior to the initial concrete placement. The Contractor shall provide the Engineer safe access to the locations where readings will be taken, to observe the initialization of the loggers and record relevant information. This information shall include each logger serial number, location in the placement and start time. Access shall also be provided as needed for subsequent readings, as required by the Engineer.

g. Each logger for each placement shall be connected to the Wireless Remote Boxes purchased by the Contractor. The Contractor shall provide as many Wireless Remote Boxes as necessary to monitor all loggers simultaneously. The Contractor shall be aware that a sufficient quantity of Wireless Remote Boxes must be on hand to monitor all of the loggers for all of the placements being actively monitored at any given time during the project. The Contractor shall also maintain two (2) spare Remote Boxes or 10% of the total on hand, whichever is larger, in operating condition at all times.

h. The Contractor shall maintain the wireless system in operating condition, including maintaining any batteries at sufficient charge and protecting the units from damage due to the environment and other factors. This shall be done to ensure that the Remote Boxes are capable of retrieving and transmitting data on a daily basis for the duration of the specified monitoring period for the concrete placement.

i. The Contractor shall have at the Contractor's field office a Wireless System Radio Base Station compatible with the Wireless Remote Boxes and the same model shall be provided to the Engineer, as described in **Subsection 607.02.2**. Both Wireless System Radio Base Stations shall be configured to access all of the active Wireless Remote Boxes at any given time without reconfiguration of any component. Upon setup of each Wireless Remote Box and prior to placement of the concrete, the Contractor shall test the remote operation of the system to verify that it works properly and that all loggers that are to be connected to the Wireless Remote Box

can be accessed. The Contractor may, at his discretion, have a handheld reader for the loggers. However, this shall not be used, except to configure the loggers initially or to collect data in the event of a problem with a Wireless Remote Box. Any such problem shall be corrected within 24 hours. Upon connection/reconnection of a Wireless Remote Box, the operation shall be tested as described above.

j. Automated temperature measurements shall be downloaded within one hour of the start of each calendar day during which any element of temperature control is in place. Secure data files from each logger shall be provided to the Engineer on a daily basis.

k. The peak concrete temperature at any location within the mass shall not exceed 155°F at any point in time. Failure to maintain a maximum peak concrete temperature less than or equal to 155°F will be cause for rejection of the concrete placement by the Engineer.

l. The temperature differential shall not exceed 35°F or the value of the variable limit (if approved) at any point in time. Failure to control the maximum concrete temperature differential less than or equal to the specified limit may be cause for rejection of the concrete placement by the Engineer. Malfunctioning sensors, as determined by the Engineer, shall be excluded from the differential calculation.

m. The placement shall be completely protected from exposure to precipitation to prevent cooling of the surface. Such protection shall be maintained until temperature control is no longer required.

n. Forms shall remain in place until the estimated strength of the concrete surface exceeds 2500 psi based on the lowest indicated maturity from the data loggers and until the differential between the mean center temperature and ambient temperature is less than 30°F and decreasing. Ambient temperatures must be rising at the time of form removal. Forms shall not be removed prior to meeting all other requirements listed elsewhere in the Contract Documents.

o. Tenting, erecting windbreaks, covering with plastic or curing blankets or other means may be necessary to protect the concrete surface from rapid cooling after form removal. Any and all such measures shall be at no additional cost to the State.

p. Concrete surfaces shall be protected when the temperature differential between the peak temperature and ambient temperature is greater than 30°F.

q. Mass concrete temperature control procedures shall remain in effect until the temperature differential between the average peak temperature and the 3-day mean ambient low temperature is less than 35°F.

r. Mass concrete elements exposed to water shall have reached at least 28 days compressive strength as indicated by the approved Maturity Curve and shall have a peak temperature-to-water temperature differential less than 35°F prior to exposure.

s. Written approval shall be obtained from the Engineer before removing temperature control.

607.05.2 Curing. Curing requirements of **Subsection 601.03.8** and **Subsection 808.03.09** shall apply, except as follows:

Mass concrete placements shall be continuously moist cured for at least 14 days and until the 28 day compressive strength as indicated by the approved Maturity Curve is achieved. Maintaining moisture on the top surface with forms in place shall be considered adequate moist curing. If strength and thermal control are achieved prior to 14 days, forms may be removed but moist curing must be continued.

Water used for curing shall be fresh water and shall not contain any salts or other components harmful to concrete. The temperature of any water used for moist curing of mass concrete shall be controlled to within 30°F of the peak concrete temperature.

607.05.3 Temperature Control Failure. Failure to meet the temperature control requirements of this specification may be cause for rejection of the concrete. Subsequent mass concrete placements shall be immediately halted. The Contractor shall investigate the events that produced the failure, and shall submit a written report to the Engineer. The investigation shall include a thorough examination of the concrete placement, the reasons for non-compliance with these requirements and shall document the width and extent of all visible cracks (if any), after cleaning the surface to fully expose them. Surface crack intensity shall be measured after monitoring shows the temperature as measured by all sensors near the concrete surface has dropped to within 10°F of the concrete temperature, as measured by the sensors at the center of thermal mass. The investigation shall be conducted by a licensed Rhode Island Professional Engineer, and shall present crack repair options for approval by the Engineer in accordance with **Subsection 607.05.4**.

The Contractor shall remove all equipment and materials from the mass concrete element and clean the surface for the Engineer to verify the Contractor's measurements of the crack intensity. The Contractor shall provide safe access for the Engineer's inspection, at no additional cost to the State.

At the discretion of the Engineer, repair or removal and replacement of the rejected placement may be required of the Contractor. If required, repair, or removal and replacement of the rejected placement shall be performed at no additional cost to the State.

At the discretion of the Engineer, the Contractor shall be required to submit a revised Mass Concrete General Temperature Control Plan to address any deficiencies identified by the investigation, at no additional cost to the State.

Subsequent mass concrete placements shall not resume without written approval by the Engineer.

There shall be no claims for additional payment by the Contractor, nor will there be an extension of the project Completion Dates for any corrective actions required as a result of the rejected concrete and subsequent corrective measures to address any deficiencies identified by the investigation.

607.05.4 Crack Repairs. Cracking determined to be due to thermal issues shall be repaired by approved methods. Determination of when cracking is caused by thermal issues will be solely by the Engineer. No repairs shall begin until the Engineer has approved the repair plan.

In case of thermal cracking, the Contractor shall suspend further work on members of similar size and configuration, submit a written explanation of the thermal cracking and additional steps to be taken to eliminate future thermal cracking, and submit proposed modifications in writing to the Engineer for review. Concrete placement may not resume until the Engineer approves the proposed modifications.

607.06 METHOD OF MEASUREMENT. "Mass Concrete" will not be measured for payment.

607.07 BASIS OF PAYMENT. No separate payment will be made for this item. Compliance with the above requirements shall be considered incidental to placement of mass concrete. Costs for this item shall be included in the bid prices of the appropriate items as listed in the Proposal.

Revise **Section 701; Culverts and Storm Drains,** pages 7-1 through 7-7 of the RI Standard Specifications for Road and Bridge Construction and pages AC-40 through AC-42 of the January 2011 Compilation of Approved Specifications as follows.

SECTION 701

CULVERTS AND STORM DRAINS

- **Replace Subsection 701.02.1; Non-Metallic Pipe in its entirety with the following.**

701.02.1 Non-Metallic Pipe. Concrete, Clay, Fiber, Vitrified Clay, Vitrified Clay Lined Concrete, and Plastic Pipe shall conform to applicable requirements of **Subsection M.04.01** of these Specifications.

a. Smooth Interior Corrugated Polyethylene Pipe and Smooth Interior Corrugated Polypropylene Pipe. Pipe, couplings and fittings for polyethylene pipe shall conform to the applicable requirements of AASHTO M294 and ASTM F2306. Pipe, couplings and fittings for polyproplyene pipe shall conform to the applicable requirements of AASHTO M330 and ASTM F2881. The following provisions shall also apply:

1. The pipe shall be Type S, meet the requirements of the AASHTO NTPEP Quality Audit Program for High Density Polyethylene Pipe and polypropylene pipe, and shall be included in the Department's Approved Materials List.

2. The basic materials shall be virgin or cleaned, reworked polyethylene or polypropylene compounds. No recycled materials shall be used.

3. All joints shall be watertight in accordance with ASTM D3212, and shall be sealed with elastomeric gaskets that conform to ASTM F477.

- **Replace Subsection 701.03.6 para. (a) with the following.**

701.03.6 Smooth Interior Corrugated Polyethylene Pipe and Smooth Interior Corrugated Polypropylene Pipe. The following additional requirements apply to these classifications of pipe.

a. Limitation of Use. Polyethylene and polypropylene pipe may only be used where the top of the pipe will be at least 3 feet below the finish grade.

[Remainder of **Subsection 701.03.6** is unchanged**]**

- **Replace Subsection 701.04.1; Culverts and Storm Drains in its entirety with the following.**

701.04.1 Culverts and Storm Drains. "Culverts and Storm Drains" of the various types of materials and sizes indicated on the Plans, both new and re-laid, including “Smooth Interior Corrugated Polyethylene Pipe,” and “Smooth Interior Corrugated Polypropylene Pipe” will be measured in linear feet of continuous runs of such pipe actually installed in accordance with the Plans and/or as directed by the Engineer. Pipe with sloped or skewed ends will be measured along their respective inverts.

- **Replace Subsection 701.05.1 para. (a.) with the following.**

a. Smooth Interior Corrugated Polyethylene Pipe and Smooth Interior Corrugated Polypropylene Pipe. The accepted quantities of the various sizes of “Smooth Interior Corrugated Polyethylene Pipe” and “Smooth Interior Corrugated Polypropylene Pipe” indicated on the Plans will be paid for at their respective contract unit prices per linear foot as listed in the Proposal. In addition to the above, the prices so-stated constitute full and complete compensation for all pipe embedment material, CLSM, buoyancy constraint, post-installation mandrel testing or hand measurement, remedial work, including all labor, equipment, tools, and all incidentals required to finish the work, complete and accepted by the Engineer.

[Remainder of **Subsection 701.05.1** is unchanged**]**

- **Replace Subsection 701.05.4 para. (a.); with the following.**

a. Class B bedding material, and all Class C and CLSM used for the installation of Smooth Interior Corrugated Polyethylene Pipe and Smooth Interior Corrugated Polypropylene Pipe will be paid for under the applicable "Culvert,” "Storm Drains,” or "Flared End Sections" Proposal items and, therefore, will not be paid for separately. The single exception relates to the replacement of unsuitable material. In this case, Class B bedding will be paid for separately as set forth in **Subsection 205.05.5** of these Specifications.

Remove **Subsection 808.03.9**; **Curing Concrete**, pages 8-65 and 8-66 of the RI Standard Specifications for Road and Bridge Construction in its entirety and replace it with the following:

808.03.9

CURING CONCRETE

808.03.9 Curing Concrete. Portland cement concrete shall be cured in accordance with the requirements of **Subsection 601.03.8; Curing**, except that all placements designated as mass concrete shall follow the requirements of **SECTION 607**. The determination of what placements shall be treated as mass concrete shall be in accordance with the requirements of that section.

Remove **Section 809; Precast/Prestressed Structure Concrete Masonry**, pages 8-69 to 8-79 of the RI Standard Specifications for Road and Bridge Construction and pages AC-57 and AC-58 of the January 2011 Compilation of Approved Specifications in its entirety and replace it with the following:

SECTION 809

PRECAST/PRESTRESSED STRUCTURE CONCRETE MASONRY

809.01 DESCRIPTION. The work of this Section consists of the provision of precast, prestressed, concrete elements, both pre-tensioned and post-tensioned, at the locations and to the details indicated on the Plans, all in accordance with these Specifications.

809.01.1 General. Prestressed concrete structural elements shall be manufactured in accordance with the publication of the Prestressed Concrete Institute titled **Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products**, MNL 116, current edition. This manual provides principles and guidelines for the manufacture of prestressed concrete products.

809.01.2 Compensation for Out-of-State Inspection Services.

a. Basis of Compensation. In the event that a Contractor selects a subcontracting company that is beyond a 50-mile radius of the Department's base of operation, deemed to be the State Office Building, the Contractor shall compensate the State for the costs of travel and inspection services, as outlined in **Subsection 809.05; Basis of Payment** for the days of inspection services as identified herein.

b. Definition of Inspection Services. The Department will conduct inspections of the plant and laboratory, witnessing of trial batches, full-time acceptance testing and part-time Independent Assurance Sampling and Testing (as defined in the Department's Materials Section Master Schedule) for all phases of production, repair of products, loading, shipping and any other related operations, including travel days, as deemed necessary by the Engineer. Inspection services days or part thereof shall also include weekends, holidays and shutdowns due to the Contractor's inability to produce.

809.02 MATERIALS.

809.02.1 Drawings.

a. Contract Plans. Plans which accompany the contract documents are designated as contract Plans. These are not intended to be shop drawings.

b. Shop Drawings. The Contractor shall submit complete and accurate shop drawings to the Engineer for approval in accordance with **Subsection 105.02, Plans and Shop Drawings.** The Contractor shall be responsible for modifying the dimensions of prestressed units to compensate for elastic shortening, shrinkage, grade corrections and other phenomena that make in-process fabricating dimensions different from those shown on the Plans. Approval of the shop drawings by the Engineer shall not relieve the Contractor from the responsibility for the correctness of all dimensions shown on these drawings. These drawings shall be made as soon as possible after the award of Contract and they

shall be designated as shop drawings. No fabrication shall take place until after the shop drawings have been approved and the Engineer has received prints made from the approved shop drawings.

1. Information Required on Shop Drawings. The shop drawings shall include but not be limited to the following information:

(a) Plan layout of structure indicating the piece mark assigned to each precast/prestressed unit.

(b) A tensioning and detensioning schedule for all products to be fabricated.

(c) Complete details, including anticipated initial and shipping cambers, tensioning force (initial and final), concrete compressive strength for stripping of forms (for precast elements, load transfer strength for prestressed elements, handling strength and 28-day strength for shipping), class of concrete, and type and location of lifting devices.

(d) Shop drawings shall clearly indicate all deviations from the precast/prestressed unit details shown on the Plans.

(e) For drawings and other relevant documentation for prestressed concrete elements refer to "Prestressed Concrete Notes" indicated on the Plans.

2. Information Required with Shop Drawings. The following information shall be submitted with the shop drawings.

(a) The name of the manufacturers of the reinforcing and prestressing steels, including alternate sources and appropriate Certificates of Compliance.

(b) Material and manner of sealing the exposed portions of the prestressing steel.

(c) Calculations of strand elongation for each unique casting length (grip-to-grip).

(d) Proposed method of handling and transporting prestressed concrete units to the project site.

(e) Submission for the Engineer's approval of a detailed plan for curing the precast/prestressed elements. This detail plan shall include the following:

(1) Curing Method.

(2) Providing for enclosures, indicating method of holding down enclosure safely in place.

(3) Heating devices, types and location around the structure.

(4) Method of monitoring time/temperature of hardened concrete.

(5) Backup systems as required.

The Engineer will review shop drawings within forty-five (45) calendar days. A set of shop drawings is deemed to be all drawings received by the Engineer from the Contractor for a particular contract on any calendar day. If the shop drawings are detained for examination for a period longer than

that stated above, such detention will be taken into account when considering application by the Contractor for an extension of time for the completion of the Contract.

809.02.2 Concrete. The Contractor shall be responsible for designing a concrete mix to produce the strength and other characteristics specified on the Plans in accordance with the applicable requirements of **SECTIONS 601** and **M.02; PORTLAND CEMENT CONCRETE.**

809.02.3 Steel. Except as noted herein, reinforcing steel shall conform to the requirements of **SECTION 810** of these Specifications and as shown on the Plans. All reinforcing steel used in the fabrication of precast/prestressed concrete structural elements shall be tested before being placed in any of the products.

a. Other Requirements. Steel components shall also conform to the following additional requirements.

1. Chairs or other devices necessary to ensure the proper placement of steel items shall be galvanized, plastic or epoxy coated and must be capable of supporting the loads without deformations, all as approved by the Engineer.

2. Prestressing steel shall meet the requirements of **Subsection M.05.03** of these Specifications.

3. Bearing plates, if required, shall meet the applicable requirements of **SECTION M.05; METALS**, of these Specifications.

4. Coated Steel. All breaks in coating shall be repaired with an approved patching material, used in accordance with the manufacturer's recommendations, before placement in the form. Coated tie wires shall be used in conjunction with coated rebars.

5. Any additional strands or reinforcing steel, wire mesh etc., shall be subject to approval of the Engineer and be provided at no additional cost to the State.

809.03 CONSTRUCTION METHODS.

809.03.1 Equipment Checks and Calibration. A calibration certificate indicating the load calibration of each gauge and hydraulic jack combination used for tensioning shall be provided. The gauge shall have clearly marked divisions of 2 percent of the final tensioning force that are easily readable at the initial and final tensioning force. The calibration of each combination gauge and hydraulic jack shall be made every 6 months. Any repair to the rams, such as replacing the seals or changing the length of the hydraulic lines requires the recalibration of the ram with a load cell.

The Contractor shall have a compressive strength testing machine conforming to the AASHTO T22 Specifications. The Contractor shall have the ability to make, store and cap the specimens in accordance with AASHTO Specifications. The compressive strength testing machine shall be calibrated at least once every 6 months and the calibration certificate submitted to the Engineer. The Engineer shall be provided full access to the compressive testing machine.

809.03.2 Inspection of the Plant and Facilities. Within 30 days after award of contract the Contractor shall notify the Engineer so that the plant and facilities to be used in fabrication of concrete structural

elements may be inspected for approval. Fabrication of units will be monitored and inspected by the Engineer. The Contractor shall provide a plant laboratory conforming to the requirements of **Section 930; Plant Field Laboratory**. The Contractor shall notify the Engineer and receive confirmation from the Engineer of any work to be performed. The Contractor may perform work in the absence of the Engineer with the Engineer's prior written approval. The Contractor shall keep the Engineer informed of the day-to-day scheduling of operations. The Engineer shall be provided free access throughout the fabrication plant to observe that the work being performed is in conformance with the Contract Documents.

a. Required Notifications. Notification shall be given to the Engineer prior to:

1. Commencement of production: 1 month.

2. Recommencement of work after a suspension of 48 hours or more;

    (a) a minimum of 2 days when the Engineer is on site,

    (b) a minimum of 2 weeks in the absence of the Engineer from the site.

3. Unit shipping;

    (a) a minimum of 2 days when the Engineer is on site,

    (b) a minimum of 2 weeks in the absence of the Engineer from the site.

The Contractor shall be aware that these requirements may have a direct impact on project schedules.

809.03.3 Concrete Forms.

a. General. Forms shall be constructed of various materials such as plywood, concrete, steel, plastic, polyester resins reinforced with glass fibers, plaster or a combination of these materials, all to the satisfaction of the Engineer. They must be carefully aligned, clean, rust-free, substantial and firm, securely braced and fastened together and sufficiently tight to prevent leakage of mortar. All wooden forms shall be sealed to prevent absorption. Wooden forms that are blistered, warped, delaminated or deteriorated such that they do not perform to the satisfaction of the Engineer shall be replaced by the Contractor. All drill holes or uneven surfaces shall be repaired. All forms shall be strong enough to withstand the action of mechanical vibrators. All forms for each unit shall be approved by the Engineer prior to placing concrete.

All form surfaces that come in contact with the concrete shall be thoroughly treated with a form release coating approved by the Engineer and in the manner and rate specified by the manufacturer. Forms so treated shall be protected against damage and dirt prior to placing concrete.

Any form release coating material that adheres to or discolors the concrete shall not be used.

b. Critical Dimensions. Prior to placing concrete, the Contractor shall verify that all critical dimensions, such as lengths, widths, cable locations, position of weld plates and bearing plates, bulkhead locations and dimensions, blockout locations, post tensioning duct locations, keyway dimensions, dimensions on skewed or battered ends, expansion duct locations, insert locations, fixed and expansion

sleeve locations, locations of voids, location of drip grooves, sizes of voids and critical dimensions indicated on drawings shall conform to the tolerances indicated in the current edition of P.C.I. MNL 116.

c. Void-Producing Forms. Void-producing forms shall be constructed of a waterproof material and have a one inch diameter vent placed at each end of the void or as indicated on approved drawings. All voids shall be vented upon removing the concrete element from the form.

809.03.4 Reinforcement and Prestressing Steel. Prior to installation in the units, reinforcement and prestressing steel shall be free of rust, frost, dirt, oil, paint, corrosion, or any foreign material that may prevent bonding between the steel and the concrete, in accordance with **Section 810** of these specifications and to the satisfaction of the Engineer. Prestressing steel that has sustained physical damage at any time will be rejected. The development of pitting or other results of corrosion (other than rust stain) will be cause for rejection when so directed by the Engineer. Prestressing steel exhibiting rust stains shall be examined by the Contractor and the Engineer prior to its placement in the forms to determine if pitting exists. Any coil that is found to contain broken strands will be rejected and the coil replaced.

The splicing of prestressed strands inside the casting form is not permitted. Splicing of strands outside the casting form may be allowed only with prior written approval of the Engineer. Tack welding of bar reinforcement will not be allowed under any circumstances.

Placing and fastening of all steel reinforcement shall be in accordance with **Subsection 810.03.4** of these Specifications.

The Contractor shall furnish a manufacturer's Certificate of Compliance and a Mill test report per size, per heat number, per source and per load for all prestressing strands. The Engineer may obtain strand steel samples for verification testing.

809.03.5 Tensioning of Prestressing Strands. The prestressing elements shall be tensioned to provide the required prestress shown on the Plans and shall conform to the applicable requirements of the current edition of P.C.I. MNL 116.

All the strands of a pretensioned member shall be free from kinks or twists before tensioning operations are started. Any unwinding of the strand in excess of one turn, after tensioning operations are begun, shall not be permitted. All strands shall be tensioned to 20 percent of final jacking force before elongation readings are started, unless otherwise directed by the Engineer. The equipment for producing this initial tensioning load shall provide a means for accurately measuring the force. When the initial tensioning load is applied by pressure jacks, they shall be equipped with a proper gauging system for the initial force.

The pre-designated initial force shall be applied to each strand. This load shall be the starting point for measuring additional tensioning for tension determination by the elongation method.

When comparing theoretical gauge and actual gauge readings, and theoretical elongations and actual elongations, the requirements of the current edition of P.C.I. MNL 116 must be observed.

The elongation computation shall take into account strand anchorage slippage, horizontal movement of abutments, bed shortening and any change in temperature of the prestressing steel between

tensioning and time when concrete takes its initial set if this change is expected to exceed 30^{O}F. The final pretensioning shall not be done at temperatures below 20^{O}F.

The strands that are draped shall be stressed no higher than required design stress minus the stress increase in the strand from forcing it into a draped profile.

If the strands are tensioned in their draped position, they shall be supported by rollers at each point of change in direction. The holdup rollers between members and at the ends of the members shall have either bronze bushings or roller bearings that shall be free running and kept well lubricated. Rollers at the hold-down points shall be free running and of a type that will produce a minimum amount of friction. If the load for a draped strand, as determined by elongation measurements, exceeds 5 percent less than that indicated by the jack gauges, the strand shall be tensioned from both ends of the bed and the load as computed from the sum of elongation at both ends shall agree within 5 percent of that indicated by jack gauges.

It is anticipated that there may be a discrepancy in indicated stress between jack gauge pressure and elongation. In such event, the load used shall produce a slight overstress rather than understress. When a discrepancy between gauge and elongation measurements of more than 5 percent occurs, the entire operation shall be carefully checked and the source of error determined and corrected before proceeding further. The use of a load cell may be required by the Engineer to check the applied load. The load cell shall be calibrated at least once every 6 months or whenever it is deemed necessary by the Engineer.

Prestressing steel strands in pretensioned members, if tensioned individually or in groups (i.e., more than one), shall be checked by the Contractor for loss of prestress not more than 3 hours prior to placing concrete. The method and equipment for checking the loss of prestress shall be subject to approval by the Engineer. All strands that show a relaxation loss of prestress in excess of 3 percent shall be retensioned to the designed final jacking force.

When stressing grouped strands simultaneously, each tendon must first be brought to initial tensioning load. The final tensioning load shall be applied to the group using a procedure approved by the Engineer.

During tensioning of any one strand, the process shall be so conducted that the applied load and the elongation of the strand may be measured at all times.

Any prestressed strand which has been tensioned for over 48 hours without the placement of concrete must be checked for elongation or loss of stress before placing of concrete. If losses occur the strands shall be detensioned and then retensioned in accordance with the design loading requirements.

809.03.6 Handling and Placing Concrete. No concrete shall be placed without the Engineer's approval. Concrete shall be handled and placed in accordance with the applicable requirements of **SECTIONS 601** and **808; PORTLAND CEMENT CONCRETE** and **CAST-IN-PLACE STRUCTURE CONCRETE MASONRY**, respectively.

Suitable means shall be used for conveying and placing concrete without segregation. The concrete mixture shall not be dropped from a height greater than one foot above the top of the forms. Special care shall be taken to deposit the concrete in its final position in each part of the form.

The fresh concrete shall be consolidated in place by internal vibration and, if necessary, also by external vibration. The vibrators shall be of a type and design approved by the Engineer and the size of the vibrating head will be governed by the spacing of the prestressing and reinforcement. Handheld vibrators shall be equipped with rubber tipped heads when used to consolidate around epoxy-coated reinforcement. Vibrators shall be used only to consolidate the concrete after it has been properly placed and shall not be used for moving concrete along the forms.

The Contractor is responsible for the proper vibration and consolidation of concrete. Only properly trained personnel shall be used in the placing and finishing operations.

809.03.7 Finishing. After all the concrete has been placed and thoroughly compacted as required under **Subsection; 809.03.6** above, the tops of units shall be magnesium-float finished, unless specified otherwise. To assure production of well-formed concrete elements with an overall pleasing appearance, all surfaces of concrete shall be true and even, free from rough, open or honeycombed areas, depressions, air pockets or projections. All exposed surfaces shall be finished by bagging or as otherwise indicated. In addition, special care and effort shall be taken when finishing all fascia portions of concrete elements.

809.03.8 Curing. Curing shall conform to Section 601 and as modified herein.

a. Curing by Moist Method without Supplemental Heat. The exposed surfaces of precast/prestressed concrete elements cured without supplemental heat shall be kept continuously moist by fogging, spraying, covering with wet mat, or with an impermeable cover. The concrete unit must be kept at a temperature of not less than 50^{O}F until such time as the compressive strength of the concrete reaches the strength specified for transfer of prestress or stripping.

b. Accelerated Curing System. Curing with Live Steam – Steam curing for precast/prestressed elements shall conform to the following provisions:

1. After placement of the concrete, elements shall be held for a minimum 4-hour pre-steaming period. If the ambient air temperature is below 50^{O}F, steam shall be applied during the pre-steaming period to hold the air surrounding the element at a temperature between 50^{O}F and 90^{O}F.

2. To prevent moisture loss on exposed surfaces during the pre-steaming period, elements shall be covered as soon as possible after casting or the exposed surfaces shall be kept wet by fog spray or by wet blankets.

3. Enclosures for steam curing shall allow free circulation of steam about the element and shall be constructed to contain the live steam with a minimum moisture loss. The use of tarpaulins or similar flexible covers will be permitted, provided they are kept in good condition and secured in such a manner to prevent the loss of steam and moisture.

4. Steam at the jets shall be low pressure and in a saturated condition. Steam jets shall not impinge directly on the concrete, test cylinders, or forms. During application of the steam the temperature rise within the enclosure shall not exceed 40^{O}F per hour. The curing temperature throughout the enclosure shall not exceed 150^{O}F and shall be maintained at a constant level for a sufficient time necessary to develop the required transfer strength. Control cylinders shall be covered to prevent moisture loss and shall be placed in a location where the temperature is representative of the average temperature of the enclosure.

5. Calibrated temperature recording devices that will provide an accurate continuous permanent record of the curing temperature shall be provided. A minimum of one temperature recording device per 100 feet of continuous bed length and not less than two per bed, one at each end will be required for checking temperature.

6. Once minimum transfer compressive strength is achieved, members in tension shall be detensioned immediately after the termination of steam curing while the concrete and forms are still warm or the temperature under the enclosure shall be maintained above 60^{O}F until the stress is transferred to the concrete.

7. Initial curing of precast/prestressed concrete will be considered complete once the minimum specified transfer or form stripping strength is verified by compressive strength cylinder test results.

8. Radiant heat may be applied by means of pipes circulating steam, hot water or oil, or by electric heating elements. Radiant heat curing shall be done under a suitable enclosure to contain the heat and moisture and minimize losses by covering all exposed concrete surfaces with plastic sheeting.

c. Other Curing Methods. If the Contractor proposes to cure the elements by any other method it must be submitted in detail to the Engineer for approval.

809.03.9 Testing.

a. General. Acceptance, Contractor quality control and Independent Assurance Sampling and Testing shall conform to the requirements of **Section 601** and as modified herein. All materials required for testing shall be furnished by the Contractor at his own expense. Acceptance test samples will be taken by the Engineer except where contractual restrictions are present, in which case sampling will be witnessed by the Engineer with samples immediately taken into custody by the Engineer. The Contractor shall have no claims for compensation or extension of time in the event his work is delayed while waiting approval of the materials furnished for testing.

b. Quality Control Testing. Quality Control Testing of concrete is a mandatory requirement, and shall be performed by the Contractor in conformance with the following provisions:

1. Cylinder specimens for form stripping, detensioning, handling, shipping and application of external loads shall be cast by the Contractor and shall be cured and tested in accordance with procedures outlined in **SECTION 601; PORTLAND CEMENT CONCRETE**, of these Specifications. The Contractor shall cast a sufficient number of concrete test cylinders to ensure that enough specimens are available to determine the necessary strength test requirements. Quality Control Cylinders shall be field cured under the same curing conditions as the precast/prestressed element. The Contractor shall be responsible for furnishing the cylinder molds for all compressive test specimens.

2. Quality control cylinders shall be cast and tested in the presence of the Engineer.

3. All cylinders shall be placed within 15 feet of each end of the casting bed or as determined by the Engineer.

One cylinder from each location shall be tested in immediate succession to verify form stripping (precast), transfer (prestressed) and 28-day strengths (shipping).

All cylinders must exceed the minimum strength required for form stripping (precast), transfer (prestressed), handling and 28-day strengths (shipping), respectively.

No structure shall be shipped from the plant to the project site unless it has obtained the minimum 28-day compressive strength. Furthermore, shipping shall not occur without the RIDOT Materials inspection stamp or other documented approval of the Engineer.

c. Acceptance Testing. Acceptance testing is performed only by the Engineer and is defined in **Subsection 601.03.7; Testing of Concrete,** and shall be the methodology for "Acceptance" of all concrete elements.

809.03.10 Transfer of Prestress. Transfer of prestress shall be accomplished in the presence of the Engineer and in accordance with the approved detensioning schedule and as soon as the transfer strength is achieved and verified. The detensioning schedule must consist of, but not be limited to, the following:

1. The order of detensioning, and;

2. Each strand must be detensioned at each end and/or between each element.

At the end of each prestressed element the concrete surrounding the individual strands shall be chipped back to sound material to a depth of between 3/4-inch to 1 inch. The strands themselves shall be cut back to the same depth. The edges shall be squared off so as not to produce a "feathered" edge. Cleaning shall be by wire brushing or abrasive sand blasting to remove all dirt and residue that is not firmly bonded to the metal or concrete surfaces. The ensuing void, including the end of the strand, shall be filled with an approved non-shrink grout whose surface shall be finished flush with that of the plane surface of the product.

809.03.11 Handling. All products shall be removed from the forms in the presence of the Engineer. Adequate notice shall be given to the Engineer so that he may witness the removal operation. Extreme care shall be exercised in handling and moving precast/prestressed concrete members. Precast girders and slabs shall be transported in an upright position and the points of support and direction of the reactions with respect to the member shall be approximately the same during transportation and storage as when the member is in its final position.

The location of all dunnage and pick-up points shall be as indicated on the Shop Drawings.

Care shall be taken during storage, hoisting and handling of the precast units to prevent cracking or damage. Damaged units shall be replaced or repaired at the Contractor's expense subject to approval by the Engineer.

809.03.12 Rejection of Units. Units not fabricated in accordance with the Contract Documents, Plans, or approved shop drawings will be subject to rejection by the Engineer.

The Engineer will make a preliminary determination as to whether spalled, cracked, honeycombed, or otherwise defective concrete shall be repaired or be subject to rejection. In the event that the unit is to be repaired, the Contractor shall submit a detailed non-conformance report and a detailed repair procedure to the Engineer for approval prior to commencement of repair work.

All repair work shall be performed at the expense of the Contractor and in the presence of the Engineer. Any repair work not done in the presence of the Engineer will not be accepted.

The repaired unit will then be reinspected for approval by the Engineer.

809.04 METHOD OF MEASUREMENT. "Precast, Prestressed Concrete Elements" will be measured for the particular item or items of work as specified, and as directed by the Engineer.

809.04.1 Incidental Items. All labor, equipment, tools and materials, including but not limited to backer rods, grouting between units, post tensioning, patching of duct pockets and all incidental items required to complete the work as specified, complete, in place and accepted by the Engineer, will not be measured separately for payment but will be considered incidental to the other items of work covered in this section.

809.05 BASIS OF PAYMENT. The accepted quantities of "Precast, Prestressed Concrete Elements" of the sizes and types specified, will be paid for at their respective contract unit prices per item or items of work as listed in the proposal. The prices so stated shall constitute full and complete compensation for all labor, equipment, tools and materials, including but not limited to backer rods, grouting between units, post tensioning, patching of duct pockets and all incidentals necessary to finish the work as specified, complete and accepted by the Engineer.

a. Payment for Compensation for Out-of-State Inspection Services. The Contractor shall pay for such out-of-state inspection services by the day (per diem) for each Department Engineer and/or Technician assigned to the plant for inspection of the project. The rates, which shall be established based on the radius, in miles, from the base of operations, shall be as follows:

Distance in Radial Miles	**Rates per Inspector/Day**
51-to-100 miles	$150.00
Greater than 100 miles	$500.00

There will be a maximum charge of one inspector for precast operations and two inspectors for prestress operations. The Contractor will be credited 50 percent when a plant is performing operations for two or more Department contracts.

The contractor will not be charged for an initial inspection of a company or a single follow-up inspection for plant approval prior to initial production.

The compensation payment for out-of-state inspection services will be paid as a progress payment deduction.

Remove **Section 810; Reinforcing Steel**, pages 8-79 through 8-84 of the RI Standard Specifications for Road and Bridge Construction and AC-59 and AC-60 of the January 2011 Compilation of Approved Specifications in its entirety and replace it with the following.

SECTION 810

REINFORCING STEEL

810.01 DESCRIPTION. This work consists of providing reinforcing steel, both plain and deformed, and uncoated and galvanized; spiral wire; and welded wire fabric of the quality, type, size and at the locations indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

This work also includes the drilling and grouting of reinforcing dowels.

810.02 MATERIALS. The following materials shall conform to the applicable requirements of the indicated **Subsections of PART M; MATERIALS:**

a. Subsection M.05.01, Bar Reinforcement.

b. Subsection M.05.02.1, Wire Fabric.

c. Subsection M.05.02.2, Spiral Wire.

d. Subsection M.05.05, Galvanized Reinforcement.

810.03 CONSTRUCTION METHODS.

810.03.1 Bar Schedules and Bending Diagrams. The Contractor shall prepare and submit complete bar schedules and bending diagrams, including material weights for all reinforcing steel on the project. Fabrication of the reinforcing steel shall not commence until written approval of the submittals has been granted by the Engineer. The Contractor is solely responsible for the accuracy of the schedules and diagrams.

810.03.2 Test Bars. The Contractor shall include extra bars for field sampling, for supplementary analyses; and for weight, tensile and bending tests, as required by the Engineer. In general, one bar size of a length sufficient for two separate 36 inch samples will be randomly selected by the Engineer for testing. The Contractor shall provide samples when and as directed by the Engineer.

If tests results do not conform to previous reports or to the minimum requirements of tensile and bending properties, those portions of the shipments affected will be rejected. However, the Contractor will be entitled to two additional tests of other bars in the same lot for each failed test, and if the average of all samples tested from the lot is acceptable, the material will be accepted. Any material unsuitable for use because of inaccuracies in bending, or other properties which render it unfit will be rejected.

The weight of test specimens shall be primarily used in calculations to determine the effective area for tensile tests. If the weight of test specimens exceeds the permissible lot variation from theoretical weights as specified in ASTM A615, sufficient material will be weighed to produce a reliable determination of effective area. The Contractor shall provide for the required handling without extra compensation.

810.03.3 Fabrication and Delivery.

a. Bending. Bent bar reinforcement shall be cut and cold bent to the shapes shown on the Plans. Fabrication tolerances shall be in accordance with ACI 315-92, "Detailing Manual." Bars partially embedded in concrete shall not be field bent except as shown on the Plans or as indicated elsewhere within this specification.

b. Hooks and Bend Dimensions. The dimensions of hooks and the diameters of bends shall be in accordance with the latest edition of the AASHTO LRFD Bridge Design Specifications or ACI 318/318R-95, "Building Code Requirements for Reinforced Concrete."

c. Identification. Bar reinforcement shall be shipped in standard bundles, tagged and marked in accordance with the Manual of Standard Practice of the Concrete Reinforcing Steel Institute (CRSI).

810.03.4 Handling, Storage, and Surface Condition of Reinforcement

a. Uncoated Bars. All reinforcement bar, wire, or fabric when unloaded at the site shall be stored above the ground on sills, blocking, or other supports and shall be protected from mechanical injury or corrosion causing conditions.

Immediately prior to placement of concrete, all reinforcement shall be free from dirt, loose rust or scale, mortar, paint, grease, oil, and other materials that would reduce bond. Rusted areas must be thoroughly hand-wire brushed just prior to installation. After hand-wire brushing, remaining rusted areas will be acceptable provided the minimum dimensions, cross sectional area, and tensile properties meet the physical requirements for the size and grade of steel specified.

b. Galvanized Bars. In addition to the above requirements for uncoated bars, the following apply for galvanized bars:

All systems for handling galvanized bars shall have padded contact areas for the bars wherever possible.

All bundling bands shall be padded and all bundles shall be lifted with a strongback, multiple supports, or a platform bridge to prevent bar to bar abrasion from sags in the bar bundle. The bars or bundles shall not be dropped or dragged.

Galvanized bars shall not be exposed outdoors for more than 2 months, or less if the initial presence of white oxide begins to form on the galvanized bars, unless these bars are protected per AASHTO M 284. Exposure time shall include storage time and any additional time for those sections of bars left exposed after casting.

810.03.5 Placing and Fastening.

a. Uncoated Bars.

1. General. Prior to ordering bar reinforcement, the Contractor shall carefully check all bar lists and assume full responsibility for their accuracy. All steel reinforcement shall be accurately placed in the positions shown on the Plans and firmly held in place during the placing and setting of concrete. When placed in the work reinforcement shall be free from dirt, rust, loose mill scale, paint, oil and other foreign deleterious materials.

2. Spacing and Cover. The spacing and cover of reinforcement shall be as indicated on the plans.

3. Support Systems. All bars shall be maintained the correct distance from the forms by means of blocks, hangers, chairs or other approved devices. The use of pieces of stone, brick, wood or metal pipe is not permitted. If required, precast concrete blocks placed with the small face down may be used. All metallic support systems shall have a protective coating for corrosion protection. For metallic support hardware resting against formwork, plastic tips shall be provided.

4. Fastening. Before the concrete is placed, all reinforcement shall be securely fastened together and supported with approved chairs or other approved devices. The chairs shall be properly sized and spaced to provide the specified minimum concrete clear cover. Bars shall be securely tied with wire at all intersections around the perimeter of each mat and within the interior at not less than 2.0-ft centers or at every intersection, whichever is greater. Bundles bars shall be tied together at not more than 6.0-ft centers. In any case, there shall be a sufficient number of intersections tied to prevent any movement of the mat or loose bars to the satisfaction of the Engineer.

All metallic wire ties and miscellaneous metallic hardware used for placement of reinforcing shall be plastic coated. For metallic hardware resting against formwork, plastic tips shall be provided.

All reinforcement shall be placed and tied, inspected and approved by the Engineer before placement of concrete commences.

5. Splicing Reinforcing Steel. All reinforcement bars shall be furnished in full lengths as indicated on the Plans. Splicing of bars and wire fabric reinforcing, except where so indicated, is not permitted without the written approval of the Engineer. Splices shall be staggered as far as possible. Splices shall not reduce the concrete clear cover. In addition to the above, the following shall also apply:

(a) Lap Splices. Lap splices shall be of the lengths specified on the plans. Lap splices shall not be used for bar sizes larger than No. 11. Mechanical splices shall be used for splices of bars greater than No. 11. If lap lengths are not specified on the plans, the length of each lap splice shall be in accordance with the applicable articles of the AASHTO LRFD Bridge Design Specifications for tension or compression splices. Lap splices shall be made by placing the bars in contact and wiring them together for the full lap length of the splice. Lap splices are not allowed in certain specific locations as described in the plans.

(b) Mechanical Splices. Mechanical splices shall be used if shown on the plans or approved in writing by the Engineer. For bars greater than No. 11, mechanical splices shall be used unless otherwise noted on the plans. Such mechanical splices shall develop in tension or compression, as required, at least

125 percent of the specified yield strength of the bar being spliced. Mechanical splices shall be installed in accordance with the manufacturer's recommendations.

(c) Welds. Welds are not permitted unless indicated on the Plans or authorized in writing by the Engineer. Where welding is indicated it shall conform to the applicable requirements of ANSI/AWS D1.4, Structural Welding Code-Reinforcing Steel.

(d) Wire Fabric. Wire fabric of the various sizes shown shall be cut to the required dimensions and placed where indicated on the Plans. Sheets of welded wire fabric shall be spliced by overlapping each other sufficiently to maintain a uniform strength and shall be securely fastened at the ends and edges. The edge lap shall not be less than one mesh in width plus 2 inches.

b. Galvanized Bars. In addition to the applicable provisions of **Subsection 810.03.5(a)** above, the following apply to galvanized bars:

1. Field Bending. Galvanized bars shall not be bent in the field more than 10 degrees, regardless of the diameter of the bend. Where field bending of galvanized reinforcing bars in excess of this limitation is indicated on the Plans or allowed by the Engineer, these bars shall be touched-up after field bending with a zinc rich primer, in accordance with Section **810.03.5(b)(5).**

2. Splices.

(a) Lap Splices. Splices for bar sizes No. 11, or smaller, shall be made by either a lap splice or mechanical splice.

(b) Mechanical Splices. Mechanical splices are required for bars larger than No. 11. These splices shall be galvanized.

(c) Welds. Prior to welding of reinforcing fabric, the galvanized coating shall be removed for the length of the bar to be welded plus six inches on each side of the weld. After welding, all slag, weld spatter, and other foreign material shall be removed and the spliced area shall be cleaned and re-galvanized in accordance with the field repair procedure described in **Section 810.03.5(b)(5)**.

3. Placement. Prior to placing galvanized reinforcement, all grease, dirt, mortar, and any other foreign substance must be removed from the bars. Galvanized reinforcement shall be placed in the position indicated in the contract documents and within ACI tolerances.

4. Hazardous Materials. The Contractor's operations shall conform with all OSHA regulations that apply to working with zinc based materials. Contractor's operations which may be affected by these regulations include, but are not limited to, welding splices and coating repair.

5. Field Repair. The Contractor shall field-repair damage to the galvanized coating done during shipping and handling, and replace bars that are not field repairable as described herein. Repairable damage is defined as any bare or loose spots, or breaks in the coating which affects an area smaller than one square inch.

Field repair will be allowed only when the total number of repairable damaged areas in a 10 foot length of bar is less than 6. Material with a total number of damaged areas greater than the amount specified above, or material with a damaged area greater than one square inch, will be rejected and shall be immediately removed from the work site and replaced by the Contractor at no cost to the State.

The galvanized coating shall be repaired with a zinc-rich paint by the following method:

(a) Clean the damaged area by power disk, wire brushing, sand or grit blasting, or any other suitable method approved by the Engineer to a near-white metal condition in accordance with SSPC-SP10 (1 to 2 mil anchor pattern), as a minimum. The surface shall also be clean, dry and free of oil, grease, flux residue, corrosion products, and any other foreign substance.

(b) Using a minimum of two coats, and the methods recommended by the manufacturer of the zinc-rich paint, spray or brush apply the zinc-rich paint to the area in a manner to achieve the applicable ASTM adherence and quality requirements of the original coating, and a minimum dry film thickness of 4 mils. Paint shall be applied immediately after surface preparation is complete.

(c) If the reinforcing bar needs to be cut in the field, prior to application of the zinc-rich paint, the end shall be ground smooth and the edge chamfered to ensure a uniform thickness of paint.

(d) These repair procedures are only allowed for field repairs. These procedures are not allowed for shop repairs. All repairs shall be made at no cost to the State.

810.03.6 Drill and Grout Reinforcing Dowels. Provisions for drilling and grouting dowels are set forth in **SECTION 819** of these Specifications and the applicable sections above.

810.04 METHOD OF MEASUREMENT.

810.04.1 Bar Reinforcement and Spiral Wire. "Bar Reinforcement" and "Spiral Wire", both plain and deformed and galvanized and uncoated, will be measured by the total number of pounds of each type actually placed in accordance with the Plans and/or as directed by the Engineer. The weight of plain or deformed bars will be computed using the unit weights indicated in the AASHTO LRFD Bridge Design Specifications. The weight of clips, ties, separators, chairs, mechanical splices, or other material used for fastening the reinforcing in place shall not be included for payment. No allowance will be made for the weight of the galvanizing in computing the weight of galvanized bar reinforcement.

810.04.2 Wire Fabric Reinforcement. "Welded Wire Fabric Reinforcement," galvanized and uncoated, will be measured by the number of square feet actually installed in accordance with the Plans and/or as directed by the Engineer. Galvanized coating of fabric reinforcement will not be measured separately for payment.

810.05 BASIS OF PAYMENT.

810.05.1 Bar Reinforcement and Spiral Wire. The accepted quantities of "Bar Reinforcement" and "Spiral Wire" will be paid for at their respective contract unit prices per pound as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, materials, equipment and incidentals required to finish the work, complete and accepted by the Engineer.

810.05.2 Wire Fabric Reinforcement. The accepted quantities of "Wire Fabric Reinforcement" will be paid for at their respective contract unit prices per square foot as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, materials, equipment and incidentals required to finish the work, complete and accepted by the Engineer.

Remove **Section 812; Waterstops and Flashings**, pages 8-86 to 8-88 of the RI Standard Specifications for Road and Bridge Construction in its entirety and replace it with the following.

SECTION 812

WATERSTOPS

812.01 DESCRIPTION. This work consists of the furnishing and installation of waterstops in various types of concrete joints at the locations shown on the Plans or as directed by the Engineer, all in accordance with these Specifications.

812.02 MATERIALS.

Polyvinyl Chloride (PVC) Waterstops. PVC waterstops shall be manufactured by the extrusion process from an elastomeric plastic compound, the basic resin of which shall be PVC. The compound shall contain any additional resins, plasticizers, stabilizers, or other materials needed to assure that, when the material is compounded, it will meet the performance requirements given in the table below. No reclaimed PVC or other material shall be used.

The PVC material shall comply with the following physical requirements when tested under the indicated ASTM test method.

Specific Gravity	ASTM D792	Max 1.35
Durometer Hardness	ASTM D2240	75 +/- 5
Tensile Strength	ASTM D412	Min 1.8 ksi
Elongation	ASTM D412	Min 350%
Cold Brittleness	ASTM D746	-35° F
Stiffness in Flexure	ASTM D747	Min 0.350 ksi

812.03 CONSTRUCTION METHODS. Waterstops shall be installed at locations indicated on the Plans. Where movement at the joint is provided for, the waterstop shall be capable of accommodating such movement without injury. Waterstops shall be spliced, welded or soldered to form durable continuous watertight joints.

Precautions shall be taken so that the waterstops shall be neither displaced nor damaged by construction operations or other means. Damaged components shall be repaired to the satisfaction of the Engineer at no additional cost to the State. All surfaces of the waterstops shall be kept free from oil, grease, dried mortar, or any other foreign matter while the waterstop is being embedded in concrete. Means shall be used to ensure that all portions of the waterstop designed for embedment shall be tightly enclosed by dense concrete per the manufacturer's recommendations.

A Certificate of Analysis from an approved independent testing laboratory shall be provided to the Engineer. The certificate shall state that the material furnished conforms without exception to all the requirements specified herein; and shall also include all qualitative and quantitative test results.

a. Waterstops. A manufacturer requesting approval of a waterstop shall furnish to the Engineer a 3-foot length of each type of PVC waterstop he intends to supply for approval.

b. Installation of Waterstops. The Contractor shall demonstrate proven ability and competence in the installation of these products, in conformance with the manufacturer's printed instructions.

If any part of this work is found defective at any time before the final acceptance, the Contractor, at his own expense, shall correct each defect to the satisfaction of the Engineer.

1. Preparatory Work. All waterstops shall be protected from oil, dirt, concrete spatter, damage, and shall be clean to receive concrete forms. Particular care shall be taken during installation of waterstops to eliminate all deficiencies that may cause leakage. Waterstops shall be positioned so as not to create interference with reinforcing bars and slip during installation.

2. Methods. Different methods may be used to fasten the waterstop in position. All waterstops shall be held rigidly in place by extending through slots in keyways; held by split bulkheads; tied to reinforcing bars; or other adequate methods as necessary to ensure proper support and embedment during the concreting process. The method used shall not cause damage to the waterstops or in any way compromise the integrity of the watertight seal.

3. Splicing. PVC waterstops may be butt-spliced on the job in accordance with the manufacturer's recommendations. The Contractor shall demonstrate to the Engineer that all persons who are responsible for performing splices are capable of creating the proper joint. Upon request the manufacturer shall demonstrate the splicing method for producing a strong, water-tight butt weld. Elbows, tees and crosses may also be produced by this method.

812.04 METHOD OF MEASUREMENT. Unless covered by a Special Provision, together with a corresponding Proposal Item, waterstops will not be measured separately for payment.

812.05 BASIS OF PAYMENT. Unless covered by a specific Proposal Item, waterstops will not be paid for separately and are deemed incidental to the respective pay item for the concrete listed in the proposal.

Remove **Subsection 824.03.11c; Surface Preparation for Weathering Steel – Final Cleaning**, page 8-148 of the RI Standard Specifications for Road and Bridge Construction in its entirety and replace it with the following:

SECTION 824

STRUCTURAL STEEL CONSTRUCTION

824.03.11 Surface Preparation for Weathering Steel

c. Final Cleaning. After the deck is in place and all formwork has been removed, the steel surfaces will be inspected for stains, discoloration, and any other deleterious materials which may affect the weathering of the steel in a uniform manner. Stains, discoloration, and any other deleterious materials on exterior surfaces of fascia girders shall be removed by high pressure (5000-10,000 psi) water cleaning. It may be necessary to add a chemical cleaning agent, with the approval of the Engineer, to the high pressure cleaning to remove staining. If high pressure water cleaning does not remove the stains, the Contractor shall propose an alternate cleaning method, subject to the approval of the Engineer. Once the final cleaning is accomplished no further use of the structural steel for attachment or support will be allowed.

Remove **Section 825; Painting Structural Steel,** pages 8-152 through 8-161 of the RI Standard Specifications for Road and Bridge Construction and pages AC-84 through AC-95 of the January 2011 Compilation of Approved Specifications in its entirety and replace it with the following:

SECTION 825

PAINTING STRUCTURAL STEEL

825.01 DESCRIPTION. This work consists of the thorough cleaning, preparation of surfaces, painting or repainting of new or existing steel, galvanized and metalized structures, its components or other steel materials. The above shall be performed at the locations indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

825.01.1 Submittals. The items listed below, but not limited to, are required to be submitted to the Department for approval prior to performing any work. This list does not include required submittals that are part of other related Specifications:

- Contractor applicator qualifications and material certifications. Refer to **Subsection 825.01.5** and **M.06.**
- Topcoat color samples.
- Product Data Sheets (PDS) and Safety Data Sheets (SDS) in accordance with **M.06.**
- Quality Control Plan in accordance with **Subsection 825.03.7.**
- Scaffolding/Work Platforms.
- Removal/repair procedures for unsatisfactory material (if required).

825.01.2 Toxic Caveat. The Contractor is hereby notified that existing paint systems on the State's bridges may contain toxic substances such as lead, chromium or cadmium, and that these substances are considered to be hazardous to personnel, the environment, and the public proximate to the project. The Contractor must plan and take appropriate precautions during the painting operations and for waste disposal to meet the State and Federal requirements for the protection of workers, the public and the environment. Details of these requirements are provided in **SECTION 826; PERSONNEL AND ENVIRONMENTAL PROTECTION,** of these Specifications.

825.01.3 Protection of Personnel, Public, Environment and the Structure. This provision covers the requirements for removal and containment of paint and/or corrosion products from any steel bridge or other specified appurtenances during cleaning and painting operations. Conduct all activities associated with the coating work described and specified herein in accordance with all applicable Federal, state and local regulations, **SECTION 826; PERSONNEL AND ENVIRONMENTAL PROTECTION**, the Contract Special Provisions and SSPC-PA Guide 10, "Guide to Safety and Health Requirements for Industrial Painting Projects."

Furnish and have available to the Engineer at all times during the painting operations, and at no additional expense to the Department, four approved respirators for the intended purpose, and other safety equipment needed to permit proper inspection of ongoing work. Furnish the required safety equipment before the start of work. Provide scaffolding and rigging, as needed, in compliance with OSHA regulations to enable safe and ready access to all work areas for inspection purposes.

Protect pedestrians, vehicular, and/or other traffic on or under the bridge or structure, surrounding property, surfaces, buildings, grounds, etc., against damage or disfigurement from surface preparation

media, or spatters, splashes, overspray and smears of paint or material. Furnish adequate containment materials for protection.

Remove paint drips, spills or overspray from concrete or other surfaces not designated to receive coatings. Remove and dispose of debris from cleaning operations, empty paint containers, and other refuse at no additional cost to the State. Damage caused by the Contractor's operation shall be corrected at no additional cost to the Department.

825.01.4 Pollution Controls. Prevent environmental pollution of air, soil and water caused by surface preparation media, paint spills or overspray, paint chips, dust or other harmful materials. Comply with the regulations of Rhode Island Department of Environmental Management (RIDEM) and provide notification as required. No extension of contract time or claims for costs will be allowed in order to comply with requirements of regulatory agencies.

825.01.5 Contractor Applicator Qualification. When the contract requires painting more than 1,500 square feet of steel surface, the contractor(s) performing coating application must demonstrate qualification by obtaining either The Society for Protective Coatings (SSPC) QP 1 "Standard Procedure for Evaluating Painting Contractors (Field Application to Complex Industrial Structures)" for field painting and SSPC QP-3 "Certification Standard for Shop Application of Complex Protective Coating Systems" as appropriate, or the American Institute of Steel Construction (AISC) Sophisticated Paint Endorsement (SPE). Contractors involved in the removal of paint containing lead or other toxic metals shall be certified SSPC QP2, "Standard Procedure Evaluating the Qualifications of Painting Contractors to Remove Hazardous Paint." Qualification must be maintained throughout the painting portion of the project. If it expires or is revoked for any reason, the Engineer shall be notified and may require that a qualified contractor complete the coating portion of the project.

825.02 MATERIALS. Provide materials that conform to the applicable provisions of **SECTION M.06; PAINT,** of these Specifications and to manufacturer's recommendations as applicable. In the event of a conflict between the manufacturer's recommendations and the requirements of this Section, comply with this Section unless the requirements of the manufacturer are more restrictive. In these cases, advise the Engineer of the discrepancies, in writing, and comply with the Engineer's written resolution. The decision of the Engineer in such cases shall be final.

825.02.1 Paint Supplier. Provide all paint material products including primer, intermediate coat, topcoat and thinners from the same paint supplier to ensure compatibility of components. Use the same paint manufacturer throughout all work. Provide paints that are lead and chromium free. The coating system shall be an approved NEPCOAT Qualified Product from List A or B, or other system, in accordance with **SECTION M.06; PAINT**.

825.02.2 Topcoat Color. Provide a semi-gloss topcoat in the color specified on the plans, in the Special Provisions, or elsewhere in the contract documents. Provide color chips and the Munsel and/or Federal Standard color designation for verification of the color of the topcoat. The color of the primer shall not affect the color of the topcoat.

825.02.3 VOC Compliance: All paint products must conform to all Federal, State and local requirements at the point of application as determined using EPA Method 24.

825.03 CONSTRUCTION METHODS.

825.03.1 Surface Preparation.

a. General Requirements. Surface preparation shall be in accordance with the most recent edition of the Society of Protective Coatings Specifications and additional requirements contained in the Contract Documents.

b. Engineer's Access. Provide safe access and time for the Engineer or his authorized representative(s) for inspection of all phases of work, including but not limited to surface preparation, the application of each coat of paint, including stripe coats, and for the inspection of the completed system. Provide access for sampling and testing paint material components. Samples may be subject to chemical and physical testing. Materials found to be of unsatisfactory quality will be rejected.

c. Surface Anomalies.

Corner Condition – Remove all sharp corners of steel created by flame cutting or shearing using a grinder. For organic zinc-rich primers, stripe-coat all corners resulting from sawing, burning, or shearing operations.

Preparation of Thermal Cut Edges – Thermal cut edges shall be softened before blast cleaning, as necessary to achieve proper blast profile.

Base Metal Surface Irregularities – Remove all visually evident surface defects in accordance with ASTM A6 or AASHTO M 160 prior to blast cleaning steel. When material defects exposed by blast cleaning are removed, the blast profile must be restored by either blast cleaning or by using mechanical tools in accordance with SSPC-SP 11 "Power Tool Cleaning to Bare Metal."

Weld Irregularities or Spatter – Remove or repair all sharp weld prominences, weld deficiencies (overlap, rollover, excessive concavity, convexity, or roughness) and all heavy, sharp, or loose weld spatter. Occasional individual particles of rounded tight weld spatter may remain, but widespread, sharp, or clustered particles of tight weld spatter must be removed. The removal of weld irregularities and spatter shall be removed to a flush surface.

d. Pre-Cleaning. Remove all oil, grease, and other adherent deleterious substances from areas to be painted, in accordance with SSPC-SP 1 "Solvent Cleaning", prior to abrasive blast cleaning.

e. Abrasive Blast Cleaning. Abrasive blast clean the entire surface in accordance with the cleanliness and profile required by the manufacture's Product Data Sheet. The profile shall be assessed per ASTM D 4417. All new structural steel shall be cleaned in accordance with SSPC SP-10, "Near White Blast Cleaning". The abrasive blast media shall meet SSPC-AB1 "Mineral & Slag Abrasives", SSPC-AB 2 "Cleanliness of Recycled Ferrous Metallic Abrasives", or SSPC-AB3 "Ferrous Metallic Abrasives." If the material for the project is heavily rusted or pitted, or as directed by the Engineer, measure the non-visible contaminant and remove in accordance with SSPC-Guide 15 "Field Methods for Retrieval and Analysis of Soluble Salts on Steel and Other Nonporous Substrates" to ensure detectable chloride levels are less than 10 micrograms per square centimeter.

Compressed air supply lines shall be equipped with oil traps and moisture separators. Conduct a white blotter test in accordance with ASTM D 4285 to verify the cleanliness of the compressed air. Conduct the test at least once per shift for each compressor system. Sufficient freedom from oil and moisture is confirmed if no soiling or discoloration is visible on the paper.

f. Lighting: Provide adequate lighting for all surface preparation, paint application, and inspection work. Maintain a minimum of 10 foot-candles for surface preparation and painting, and a minimum of 30 foot-candles of general area lighting for inspection. Increase the lighting if workers or other personnel have difficulty seeing. Use explosion-proof lighting.

825.03.2 Paint Application.

a. General Requirements. Apply coatings in accordance with the contract requirements, SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel" and the manufacturer's recommendations. Apply the coating to provide a continuous, uniform film of the specified thickness that is well bonded to the substrate or previously applied coating; is free of laps, streaks, sags, separation, unevenness, discoloration, and other visually evident defects; and applied within the manufacturer's specified pot life. Areas that fail any required test shall be repaired as outlined in "Removal/Repair of Unsatisfactory Material."

b. Coating Material Storage. Paint shall be stored in accordance with SSPC-QP3, SSPC-PA 1, and the manufacturer's recommendations. Record the daily storage temperature range for coating materials and verify conformance with the coating manufacturer's recommendations. Inventory the components to ensure they are used within the shelf life prescribed by the manufacturer. Record the coating batch numbers from each mixed component, the amount and type of thinner used, and the date of application.

Paint in storage shall not be exposed to temperatures lower than those recommended by the paint manufacturer. Paint exposed to temperatures lower than specified is subject to rejection or retesting.

When paint is rejected, painting operations shall cease until the rejected paint is removed from the project site.

c. Conditions for Application. Apply the paint material to clean dry surfaces. Comply with the atmospheric conditions specified below, or the written recommendations of the manufacturer, whichever is most stringent. Do not apply materials when:

- The temperature of the air or substrate is below 40°F or greater than 100°F, or is forecasted to drop below 40°F before the coating dries in accordance with the dry times specified in the manufacturer's recommendations.
- The surface temperature is less than 5°F above the dew point.
- The relative humidity is above 85%.
- There is or will be rain, mist, fog or snow during application and/or cure.
- The manufacturer's requirements for reaction time after mixing are not satisfied.

d. Methods of Application. Use brushes, rollers, spray equipment, or any combination of equipment recommended by the manufacturer and authorized by the Engineer that provides a finish that is acceptable to the Department.

e. Stripe Coats. Apply a stripe coat to corners, weld seams, around nuts and bolts or as otherwise directed in the contract documents. Do not apply the full coat of primer any sooner than 15 minutes after the application of the stripe coat, or any later than the manufacturer's recommended recoat times. Inspection personnel shall be notified and be given ample time to verify and approve the stripe coat application. Do not apply the full coat of primer until the Engineer has approved the striping. The coating material used for the stripe coat is typically the intermediate coat, but for painting metalizing or galvanize, the urethane finish coat is striped.

f. Intermediate and Topcoat. The color of the topcoat shall be as specified in the contract documents. The intermediate coat color shall contrast with both the primer and topcoat. Stripe coats may be tinted as necessary to assure proper coverage. Coating materials used to apply piece marks shall be compatible with the existent and any subsequent coats.

g. Recoat Interval. Comply with the coating manufacturer's minimum and maximum recoat interval for each coating layer. Ensure that each coating layer is sufficiently cured before applying the next scheduled coating layer.

h. Field Applied Coatings-Touchup of Primer and Intermediate Coat(s). Prior to applying field touch-up coatings, verify that all surfaces, including installed bolts, nuts and zinc-rich primer around connection plates are thoroughly cleaned of grease, oil, chalk, bird droppings, lubricants and other surface interference material. Use pressure washing or solvent cleaning, as appropriate, to remove the interference material. Use hand and power tool cleaning for spot repair of localized damage to the coating system. Pressure wash, using 1500 psi water pressure, all surfaces primed with zinc-rich primer to remove zinc salts. Do not proceed with touchup and painting until the Engineer has accepted the surface cleaning. Repair any damaged areas of coating and reapply all affected coating layers. Perform field touchup in areas around bolts, nuts, connection plates, and other areas that had not previously been painted.

i. Field Applied Coatings-Topcoat Application. Apply topcoat in the field after the Engineer has accepted the touch up (primer and intermediate) and after the structure has been erected on the project site. Verify that the amount of time between the application of the intermediate and the topcoat is within the coating manufacturer's maximum recoat time, as stated in manufacturer's recommendations. Verify that the surface is clean and dry prior to the application of the topcoat. If grease, oil, or other contaminants become deposited on the intermediate coat, remove it in accordance with SSPC-SP1 prior to the application of the topcoat.

j. Removal/Repair of Unsatisfactory Material. The coating system is unsatisfactory if any of the following defects occur: abrasion damage, peeling, blistering, wrinkling, excessive runs or sags. It is also unsatisfactory if there is evidence of application under unfavorable conditions; the workmanship is poor; unauthorized coating material was used; or for other reasons determined by the Engineer. Repair procedures for unsatisfactory material shall be submitted to the Department for approval prior to performing related work. Remove and replace unsatisfactory coating layers at no additional cost to the Department as specified below.

- **Bare steel exposed less than 4"x4" area**. When the defective paint or damage extends to the bare steel or bare steel is exposed in areas less than 4" x 4" in size, clean the surface by power tool cleaning to SSPC-SP11. Feather the surrounding paint to expose a minimum of ½" of each coat and to provide a smooth transition into the surrounding intact, adherent material. Select a primer recommended by the manufacturer of the intermediate and topcoat. For new steel, apply a spot coat of zinc-rich primer to the prepared surface. Follow with a spot coat of the intermediate and topcoat.

- **Bare steel exposed greater than 4"x4" area.** When the defective paint or damage extends to the bare steel in areas greater than 4" x 4" in size, blast clean the area in accordance with SSPC SP10, feather the surrounding paint and repair as described above.

- **Primer or intermediate coat exposed.** When the damaged or defective paint extends to the primer or intermediate coat, and for primed areas around and on connection plates, clean the surface by hand or power tool cleaning. Clean in accordance with SSPC SP2 or

SSPC SP3 to remove oxidation, zinc-salts, or contamination from the surface. Do not burnish or polish the surface. Supplement hand and power tool cleaning with pressure washing (1500 psi minimum) accompanied by scrubbing with stiff bristled brushes or other means as necessary. Feather the surrounding material to expose a minimum of ½" of each coat and to provide a smooth transition into the surrounding intact, adherent coating material.

- **All repairs**. For all repairs, roughen the paint in overcoat areas with 80 grit sandpaper to assure good adhesion of the overcoat material to the underlying paint. Also, solvent clean in accordance with SSPC SP1 and re-paint the affected areas with the intermediate and topcoat.

k. Scaffolding. Use rubber rollers or other protective devices to prevent damage to the finished coatings. In particular, sufficient support pads shall be utilized for bracing on fascias. Temporary supports or attachments for scaffolding or forms shall not damage the coating system. Areas damaged by scaffolding shall be repaired in accordance with "Removal/Repair of Unsatisfactory Material" in **Subsection 825.03.2(j)** above.

l. Technical Supervision. Coating manufacturer's representation is required for shop and field applications. The coating representative shall be present to provide the Contractor with an evaluation of the surface preparation and to provide such aid and instruction in the application of the coating system as required to obtain a satisfactory result that meets the approval of the Engineer and the manufacturer's representative. At a minimum, the services of this representative are required at the startup of all shop and/or field operations. In addition, services may be required on an "as needed" basis until painting is satisfactorily completed. The Contractor/fabricator is responsible for securing the services of the technical representative, the services of which shall be at no additional cost to the State.

825.03.3 New Steel Structures. In addition to the above, work under this paragraph shall include only those structures being built new or structures whose superstructure is being replaced in its entirety. New steel utilized in partial replacement or rehabilitation shall be addressed in **Subsection 825.03.4; Existing Steel Structures**, and in the Contract Documents.

a. General. The coating system shall be an approved Northeast Protective Coating Committee (NEPCOAT) three-coat system and shall conform to the requirements of **SECTION M.06; PAINT,** of these Specifications and the following:

Exterior Steel Surfaces. The system shall consist of a prime coat, intermediate stripe coat, intermediate coat, and topcoat.

Interior Steel Surfaces. The coating system for the interior surfaces such as: open box girders, arch ribs and ties and tubular wind bracing shall consist of a two-coat NEPCOAT exterior system. This system contains a zinc-rich primer and intermediate coat. Select the same primer and intermediate coat for application to both interior and exterior surfaces of the same steel member. Interior surfaces require no topcoat. The intermediate coat applied to interior surfaces shall be white.

b. Priming Faying Surfaces. Coatings applied to contact surfaces of bolted connections between primary members shall satisfy the requirements of the Research Council on Structural Connections (RCSC). The coating system for faying surfaces shall have a slip coefficient of Class B unless otherwise noted in the contract documents. Prior to shop bolting, verify that the coating on faying surfaces is applied at the recommended dry film thickness and the temperature adjusted cure time for shop and field slip critical bolted faying surfaces are within the range previously validated through testing by

the applicator's QC person or as given by NEPCOAT. Verify cure in accordance with ASTM D 4752 or the manufacturer's requirements.

Apply the zinc-rich primer to all surfaces. Do not apply intermediate and topcoats to faying surfaces, connection areas, and within 2" of a connection area that is to be welded. Mask or otherwise protect these surfaces to prevent the application of intermediate and topcoats. Unless noted otherwise in the contract documents, zinc-rich primer is not allowed on flange surfaces that will be embedded in concrete, although overspray is allowed on these flange surfaces.

Apply the topcoat to the same surfaces coated with the intermediate coat, except those surfaces that will be embedded in concrete.

c. Bolts (Fasteners). Bolts installed and final tightened before priming shall be prepared as necessary so as that after the steel is abrasive blast cleaned, exposed bolt surfaces shall satisfy the requirements in Table 1. Black bolts, nuts, and washers, including flat faces of nuts and bolt heads facing adjacent material, may require spot blast cleaning or other surface preparation before general blast cleaning in order to assure that the proper surface profile to obtain adhesion of the primer, has been achieved.

TABLE 1
SURFACE PREPARATION REQUIREMENTS FOR FASTENERS & BOLTS

Item	Fasteners Installed Prior to Cleaning & Primer Application		Fasteners Installed After Primer Application	
	Coating System	Surface Preparation	Coating System	Surface Preparation
Black Iron Bolts	OZ or IOZ, I, T	SSPC-SP10	IOZ, OZ, I, T	SSPC-SP 1 & 10
Galvanized (Mechanical or Hot Dip)	OZ or IOZ, I, T	SSPC-SP 1	I, T	SSPC-SP 1 & 2/3

OZ= Organic Zinc-Rich Primer IOZ= Inorganic Zinc-Rich Primer

I= Intermediate Coat T= Topcoat

If the zinc coating on shop-installed galvanized bolts is damaged during shop abrasive blast cleaning or tightening, it may be left "as is" only if the entire coating system (including the zinc-rich primer) will be applied over the fasteners.

Remove the lubricant from bolts. The Contractor shall obtain from the Fabricator the identity of solvents and methods needed to remove the lubricant. The Contractor and/or its Fabricator shall also consult with the coating supplier to assess the compatibility of the coating with any lubricant residue. The

Contractor and/or its Fabricator shall supply to the shop and field painters, the Engineer and other interested parties the information concerning the lubricant removal and the cleanliness necessary for satisfactory adhesion of the subsequent coat as described in Table 1.

Any dye coloring remaining on galvanized nuts after weathering or after removing the lubricant is not believed to be detrimental to coating performance or appearance. Use a white cloth wipe test with no color transfer to confirm that all lubricant and non-absorbed dye has been removed; only residual "stain" is permitted to remain on the surface.

d. Shipping, Storage, and Erection of Steel. Use extreme care in handling, storing, shipping and erecting the steel to avoid damage to the coating system. Do not move coated steel in the shop until sufficient cure time has elapsed to ensure that no damage will be done to the fresh coating. The steel shall not be shipped from the shop to the field until the last coating has fully cured.

Install padding on hooks and slings used to hoist the steel and use softeners approved by the Engineer to insulate the steel from binding chains. Place small structural pieces in such a manner that no rubbing will occur during shipment.

Store the steel at the job site on pallets or by other means to prevent members from resting directly on the ground or from falling onto each other.

825.03.4 Existing Steel Structures. Work under this section includes only those structures that are not included under **Subsection 825.03.3**. Specific requirements may also be found in the Contract Documents.

a. Protection of Painted Surfaces. Protect freshly coated surfaces and those surfaces not scheduled for painting from over blast and stray abrasive during blast cleaning operations. Previously coated surfaces damaged by subsequent blast cleaning operations shall be cleaned in accordance with SSPC SP10 and recoated in accordance with this specification.

b. Surface Preparation. Obtain the Engineer's approval of the preparation of all surfaces to be painted before applying any paint.

Surface preparation and coating requirements are dependent upon the scope of work and the type and condition of the existing coating system. Table 2 provides the required surface preparation methods for four scenarios. Detailed descriptions of the surface preparation methods follow the table. Specific coating material requirements for each surface preparation method are provided in **SECTION M.06, PAINT,** of these Specifications.

TABLE 2
SURFACE PREPARATION METHODS FOR SPOT, ZONE, AND OVERCOATING[1]

Scope of Work	Surface Preparation	Existing Coating System
Spot Prime and Overcoat	Method 1	Alkyd Coatings
Spot Prime and Overcoat	Method 2	Zinc-rich or Metalizing/Galvanizing with Topcoat
Zone Painting	Method 3	Alkyd Coatings
Zone Painting	Method 3 or Method 4	Zinc-rich or Metalizing/Galvanizing with Topcoat

1. The surface preparation methods shall be in accordance with the paint manufacturer's recommendations unless the requirements in this table exceed the manufacturer's recommendations. In case of conflict, the most stringent surface preparation methods shall govern as determined by the Engineer.

Method 1: Spot Prime and Overcoat an Existing Alkyd Coating System. Localized areas of corrosion or coating breakdown shall be spot cleaned using vacuum shrouded power tools in accordance with SSPC-SP3, "Power Tool Cleaning". Feather the edges of the power tool cleaned areas. The intact alkyd coating shall be prepared for overcoating by cleaning in accordance with Low-Pressure Water Cleaning (LP WC) of SSPC-SP12. The minimum acceptable water pressure is 1500 psi. Use low pressure water cleaning to remove chalk, pigeon droppings, dirt and other deleterious materials from the surface.

Method 2: Spot Prime and Overcoat an Existing Coating System that consists of a zinc-rich primer or metalizing and a topcoat. Localized areas of corrosion or coating breakdown shall be spot cleaned using vacuum shrouded power tools in accordance with SSPC-SP11, "Power Tool Cleaning to Bare Metal" or using vacuum blast cleaning equipment in accordance with SSPC-SP10, "Near White Blast Cleaning". Feather the edges of the repaired area. The intact topcoats (epoxies or urethanes) shall be prepared for overcoating by hand sanding to roughen the surface.

Method 3: Abrasive Blast Clean to remove all coating material from a well-defined zone (portion of the structure). Blast clean steel in accordance with SSPC SP10, "Near White Blast Cleaning". The surface area of the steel to be blast cleaned shall be no greater than the surface area of steel that can be primed during the same day. The maximum time lapse between surface preparation and application of the prime coat shall not be greater than 8 hours, unless atmospheric controls are used to prevent "rust back". Should any "rust back" occur prior to priming, re-clean surfaces to provide the specified degree of cleanliness. The abrasive blast profile shall be in accordance with the manufacturer's requirements as stated on the product data sheets.

Method 4: Water Wash and Ultrahigh Pressure Water Clean in a well-defined zone (portion of the structure). Thoroughly pressure wash all surfaces in the zone that will be coated, including areas of limited access such as crevices between back to back angles. Low pressure washing to remove the loose debris, followed by ultrahigh pressure water cleaning to remove all existing coating and corrosion from the steel surfaces scheduled to be coated. Comply with the requirements of SSPC-SP 12, "Surface Preparation and Cleaning of Steel and Other Hard Materials by High- and Ultrahigh-Pressure Water Jetting Prior to Recoating". Cleaned steel surfaces that are to be painted shall conform to the Visual Surface Preparation Definitions of the surface condition WJ-3 in SSPC SP12. The use of rust inhibitors is prohibited. Steel surfaces not primed within 72 hours shall be re-cleaned by water jetting. Collect all water and paint chips dislodged by the water cleaning process. Use potable filtered water for the washing to achieve a surface that is free of paint, corrosion and other visible contaminates. Measure the non-

visible contaminant and remove in accordance with SSPC-Guide 15 to ensure detectable chloride levels are less than 10 micrograms per square centimeter.

c. Limited Access Areas. The design of the structure may create areas of limited access which cannot be cleaned to the specified degree of surface preparation across every square inch of the surface. In these cases provide surface preparation as follows:

Thoroughly clean all areas that can be viewed without the use of mirrors to the specified degree of cleanliness. Localized areas of limited access due to the configuration of the structure may prevent the specified degree of cleanliness from being achieved. In these instances, at a minimum, remove all loose coatings. Inspect the surfaces by touch, using a putty knife, and by using inspection mirrors, optical or digital scopes. Cleaning and painting of these areas may require the use of specialized equipment. If the limited access area is a crevice or gap from which pack rust cannot be removed such as between mating plates, between back-to-back angles, or between structural members, apply sealants/caulks in order to seal the top and side surfaces to prevent moisture intrusion. Do not caulk the bottom crevice. Use sealants/caulks compatible with the coating system and provide written verification from the coatings manufacturer as to the compatibility of the sealant/caulk with the coating.

825.03.5 Painting Metalized or Galvanized Surfaces. The coating system shall be an approved NEPCOAT system and shall conform to the requirements of **SECTION M.06; PAINT,** of these Specifications and the following. The zinc-rich primer is not required for metalized or galvanized surfaces.

Galvanizing must be prepared in accordance with SSPC SP-16 prior to painting. White corrosion deposits such as wet storage stains must be removed before coating. Overcoat with any of the NEPCOAT approved intermediate coats followed by the application the compatible NEPCOAT approved topcoat.

The natural profile of metalized surface will not require any surface preparation.

Any process that reduces the metalize or galvanize thickness below the specification limit requires removing and re-applying the metalize or galvanize, as applicable, to meet the specification.

Apply the intermediate coat to the surface as soon as possible after the Engineer has accepted the metalizing or galvanizing surface preparation and no later than 8 hours after the metalizing application or galvanizing surface preparation, as applicable. If more than 8 hours elapses, provide written recommendations from the intermediate coat manufacturer that indicate what steps must be taken to compensate for any oxidation and make the surface suitable for the intermediate coat application. Do not implement the steps without written approval from the Engineer. Apply a stripe coat of urethane to all edges bolted connections, and other areas followed by a full finish coat of urethane.

825.03.6 Stenciling of Topcoat. After the topcoat has fully cured, provide stencil information on the inside surface of the fascia member at each abutment location unless directed otherwise by the Engineer. Use suitable black paint, or other color as approved by the Engineer to contrast with topcoat for visibility, to stencil uniform block lettering on the surface, two to three inches in height, with the following information:

- The bridge identification number as shown on the Plans,
- The month and year of completion of the coating system (MM/YYYY),
- The SSPC identification of the cleaning method, and
- Identification of the coating system (for example: IOZ/OZ, E, U) with the name of manufacturer. The following designations shall be used:

- IOZ=Inorganic Zinc Rich Primer
- OZ-Organic Zinc Rich Primer
- M=Metalized
- G=Galvanized
- E=Epoxy
- U=Urethane

825.03.7 Quality Control. The Contractor is responsible for performing quality control. Document and conduct an on-going quality control plan for the process and inspection of the materials, surface preparation, coating applications storage, and shipping of components as necessary to assure that all work is performed in strict compliance with these specifications, the Contract Documents, and the manufacturer's recommendations. This plan, at a minimum, shall address the following:
:

- Qualifications and responsibilities of the QC Manager
- Qualifications, responsibilities, and training for workers. This shall include the frequency of checks on the quality of work.
- Documentation of the proposed equipment and calibration records.
- How the QC documentation and supporting records are maintained.
- How the surface preparation of the steel prior to the application of the paint system, especially the profile, is verified and monitored (i.e. frequency). For galvanized steel, this would include the method of profiling.
- How the environmental conditions (i.e. ambient temperature, dew point, relative humidity, etc.) for various stages of the paint process are monitored and maintained throughout the duration of the project.
- How the coating materials and abrasives are verified and monitored for receipt, storage, and control.
- How the coating materials are verified and monitored for batch numbers, mixing, pot life, mix reaction time, dry time, curing, recoat time, and cleanliness of each coat prior to the application of the subsequent coat.
- How the coating materials, including galvanize and metalize, are inspected and accepted for appearance, film thickness, adhesion, etc. For galvanized surfaces, this includes the galvanize thickness after the surface preparation.
- How the coating films are inspected for defects.
- How the faying surfaces are treated and protected.
- How the coatings of steel components are protected from damage during storage, shipping, and erection.

825.03.8 Equipment and Standards. If requested by the Engineer, furnish the following Equipment and Standards. All equipment must be maintained by the Contractor and in working order at all times. Failure to do so will result in stoppage of the work until deficiencies are corrected at no additional cost to the State. These items will be returned to the Contractor when the Engineer is finished with the inspection:

- PTC Surface Temperature Thermometer.
- Psychron 566 Psychrometer (Battery Operated) with two sets of new batteries.
- Psychometric Charts for Dew Point and Relative Humidity.
- SSPC VIS Standard appropriate for the specified degree of cleaning:
  SSPC VIS 1, "Visual Standard for Abrasive Blast Cleaned Steel"
  SSPC VIS 3, Visual Standard for Power- and Hand-Tool Cleaned Steel"
  SSPC VIS 4/NACE VIS 7, "Guide and Reference Photographs for Steel Surfaces Prepared by Waterjetting."
- Wet film thickness gage.
- Positector 6000 Coating Thickness Gauge, with probes suitable for the surface to be measured.
- NIST (NBS) Calibration Standards.
- SSPC Surface Preparation Standards appropriate for the surface preparation requirements of the Contract Documents.
- Tooke guage.

825.03.9 Pre-Painting Meeting. The Contractor shall arrange for a meeting at the site where the surface preparation and painting is to be performed. Arrange the meeting at least 1 month in advance of starting the work to discuss the project requirements with the Department and the manufacturer's technical representative to allow for an examination of the surface preparation and paint application equipment. The meeting shall address methods of operation; weather-related concerns; health and safety; proper storage of material and equipment; location of recycling and dust collection and storage equipment; treatment of inaccessible areas; and visual standards to be satisfied. The quality control plan shall be provided to the Engineer for review at least two weeks prior to this meeting. Work shall not proceed until this meeting has been completed to the satisfaction of the Engineer.

825.04 METHOD OF MEASUREMENT.

825.04.1 Painting Structural Steel. "Painting Structural Steel," i.e., new steel, will be measured by the number of square feet of steel actually painted in accordance with the Plans and/or as directed by the Engineer. Cleaning, surface preparation and paint systems will be considered as incidental to the painting work and, therefore, will not be measured separately.

825.04.2 Painting Existing Structural Steel. "Painting Existing Structural Steel" will be measured by the number of square feet of steel actually painted in accordance with the Plans and/or as directed by the Engineer.

a. Surface Preparation. "Surface Preparation" will be measured by the number of square feet of steel surface actually prepared in accordance with the Plans and/or as directed by the Engineer. Separate levels of surface preparation necessary to accomplish the final specified surface preparation shall not be measured separately for payment but shall be considered included in the single square foot measurement.

825.04.3 Lump Sum Alternative. In certain cases any or all of the above items of work may be paid on a lump sum basis. In such cases, no measurement will be required.

825.04.4 Personnel and Environmental Protection. "Personnel and Environmental Protection" shall be measured in accordance with the appropriate paragraphs in **SECTION 826** of these Specifications.

825.05 BASIS OF PAYMENT.

825.05.1 Painting Structural Steel. The accepted quantity of "Painting Structural Steel" will be paid for at either the contract unit price per square foot or the contract lump sum price, as the case may be, as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, and equipment including cleaning, surface preparation, selection of paint system, painting and all incidentals required to finish the work, complete and accepted by the Engineer.

825.05.2 Painting Existing Structural Steel. The accepted quantity of "Painting Existing Structural Steel" will be paid for at either the contract unit price per square foot or the contract lump sum price, as the case may be, as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, equipment, selection of paint system, and all incidentals required to finish the work, complete and accepted by the Engineer.

a. Surface Preparation. The accepted quantity of "Surface Preparation" will be paid for at either the contract unit price per square foot or the contract lump sum price, as the case may be, for the final level of surface preparation as listed in the Proposal. Separate levels of surface preparation necessary to accomplish the final specified surface preparation will not be paid for separately but will be considered included in the single square foot or lump sum for payment. The price so-stated constitutes full and complete compensation for all labor, materials, equipment, and incidentals required to finish the work, complete and accepted by the Engineer.

Add the following new **Section 841; Pre and Post-Construction Condition Surveys** to the RI Standard Specifications for Road and Bridge Construction.

SECTION 841

PRE- AND POST-CONSTRUCTION CONDITION SURVEYS

841.01 DESCRIPTION. The work to be performed under this item consists of all labor, equipment, and materials associated with conducting pre and post-construction condition surveys of all structures and/or properties identified in the Contract Documents.

In addition, structure condition surveys shall be conducted of all structures within 200 feet, unless otherwise noted, for all vibration-inducing activities resulting from the Contractors means and methods, in accordance with the Contract Documents.

Items for which condition surveys shall be conducted include but shall not be limited to, the following:

- Existing bridge foundations, abutments and piers, and superstructures;
- Private commercial and residential buildings and other structures;
- Retaining Walls;
- Culverts

The Contractor shall submit a comprehensive list of all affected properties and structures as part of the project schedule development process Contractor's Submittal List.

Pre-construction surveys shall be conducted in accordance with the Contract Documents, and shall be conducted prior to the commencement of construction operations and vibration-inducing activities. This includes driving and removal of piles and sheeting, drilling, boring, blasting, structural demolition, and any other vibration-inducing activity resulting from the Contractor's means and methods. Work which may result in damage to properties or structures may not commence until all pre-construction survey reports have been submitted by the Contractor and approved by the Engineer.

Post-construction surveys shall be performed upon substantial completion of the contract, with the consent of the Engineer, and shall follow the same procedures and protocols utilized for the pre-construction surveys.

All damage sustained by the properties or structures surveyed due to construction operations shall be repaired by the Contractor to the satisfaction of the Engineer at no additional cost to the State or property owner.

841.02 QUALIFICATIONS AND SUBMITTALS.

841.02.1 Qualifications. Pre- and post-construction surveys shall be conducted by a Professional Engineer, licensed by the State of Rhode Island, who possesses relevant experience in performing structure condition surveys.

841.02.2 Submittals. The Contractor shall submit to the Engineer for approval the following:

a. Documentation substantiating the qualifications of the survey engineer in accordance with **Subsection 841.02.1 Qualifications**.

b. For both the pre- and post-construction condition surveys, the Contractor shall submit an original report and copies with all of the documentation to the Engineer for review. Each report shall also contain a DVD or CD with a complete electronic version of the report in PDF format and all video and still photography taken during the survey.

c. The pre-construction surveys shall be provided to the Engineer a minimum of two (2) weeks prior to starting work.

d. The Contractor shall keep on file, one copy of all results of the pre- and post-construction surveys in a suitable location on site. The documents shall be kept available for viewing during normal working hours. No duplicates, other than as specified above, of any of the survey information will be allowed without the expressed written consent of the Engineer and the property owner.

841.03 CONSTRUCTION METHODS. Pre-construction surveys shall be conducted prior to the commencement of construction operations and all vibration-inducing activities.

Documentation shall include photographs, video, sketches, and a written report of findings. Visual imaging for pre- and post-construction surveys shall include high resolution color image acquisition in a format compatible with subsequent image enhancement analysis and feature extraction. Adequate lighting shall be provided equivalent to a minimum of 55-Watt bulb illumination during still and video photography. Particular attention shall be paid to, but not necessarily limited to, the following:

1. Locations and sizes of cracks in interior and exterior walls, floors and ceilings; and missing mortar, plaster or other surface materials;

2. Damaged masonry, chimney liners and flues, and roofing, including evidence of leakage or poor roof/gutter drainage, such as staining;

3. Damaged or out-of-square doorways and windows including tightness of fit and ease of operation;

4. Walls that are not plumb, floors or ceilings that are not level, and walls, floors or ceilings that are uneven and the extent to which they are not planar;

5. Condition of the foundation walls and basement floors, especially cracking, differential movements, and signs of dampness or moisture;

6. Condition and grading of the ground surface around the exterior of the structure including evidence of drainage towards walls, low spots that pond water, cracks and irregularities in asphalt, concrete, brick or stone pavements, sidewalks, and steps and;

7. Evidence of previous repairs to the structures.

8. In the case of post-construction surveys, note all changes from the pre-construction survey.

A post-construction survey shall be performed upon substantial completion of the contract.

In the event the Contractor and/or survey engineer are unable to gain access, encounter difficulty or be refused entry to a property, they shall document the said refusal in the report and inform the Contractor and Engineer of the incident in writing. Absent a resolution, the survey engineer shall limit the structural condition survey to information that may be gained from observations outside the structure or property boundary, and document the situation in the final report.

841.04 METHOD OF MEASUREMENT. "Pre- and Post-Construction Condition Surveys" will not be measured for payment.

841.05 BASIS OF PAYMENT. "Pre- and Post-Construction Condition Surveys" will be paid for at its respective "Lump Sum" contract price as listed in the Proposal. The price so stated shall constitute full and complete compensation for all labor, materials, tools and equipment, and all incidentals required to complete the work as described in this Specification and elsewhere in the Contract Documents, complete in place and accepted by the Engineer.

Add the following subsections for Temporary Chain Link Fence and Gate to **Section 903; Fences**, pages 9-5 through 9-7 of the RI Standard Specifications for Road and Bridge Construction.

SECTION 903

FENCES - TEMPORARY CHAIN LINK FENCE AND GATE

903.01 DESCRIPTION.

903.01.1 Temporary Chain Link Fence. This work consists of the furnishing, installation and removal of temporary chain link fencing for purposes of protecting and controlling access to areas of the project as indicated in the contract documents and/or as directed by the Engineer. This work shall also include the relocation of temporary fencing to various locations within the project limits over the duration of the project, as provided for in the contract documents and/or as directed the Engineer, or as necessary to accommodate the Contractor's operations.

903.02 MATERIALS.

903.02.1 Temporary Chain Link Fence. Temporary chain link fencing, gates, posts, fittings and related hardware shall conform to the requirements of **Subsection M.08.02** of these specifications. Fittings and other hardware not specifically included in these specifications shall be standard commercial grade.

903.03 CONSTRUCTION METHODS.

903.03.7 Temporary Chain Link Fence. Temporary chain link fence may be supported by fence posts set in the ground, or means of concrete blocks or metal feet which shall provide adequate support. When utilized, fence posts set in the ground may be stabilized with grout or concrete, or may be supported by holes cored into bituminous or concrete pavement when specified in the contract or permitted by the Engineer.

Temporary fence sections may be fabricated in modular panels provided the panels are fastened together with approved clamping devices.

903.04 METHOD OF MEASUREMENT.

903.04.4 Temporary Chain Link Fence and Gate. "Temporary Chain Link Fence" will be measured in Linear Feet, end to end along the top of fence, of continuous sections actually installed in accordance with the provisions of contract and/or as directed by the Engineer.

"Temporary Chain Link Gate" will be measured by the number of such units actually installed in accordance with the provisions of contract and/or as directed by the Engineer.

903.05 BASIS OF PAYMENT.

903.05.4 Temporary Chain Link Fence and Gate. "Temporary Chain Link Fence" will be paid for at the respective unit price per linear foot as listed in the Proposal. The price so stated shall constitute full and complete compensation for all labor, material, tools, equipment and all incidentals required to complete the work, complete and accepted by the Engineer.

"Temporary Chain Link Gate" will be paid for at the respective unit price per each as listed in the Proposal. The price so stated shall constitute full and complete compensation for all labor, material, tools, equipment and incidentals required to finish the work, complete and accepted by the Engineer.

No separate payment will be made for relocating and resetting fencing required by the contract or to accommodate the Contractor's operations, or for removal at the conclusion of the project.

Add the following subsections for Split Rail Fence and Gate to **Section 903; Fences**, pages 9-5 through 9-7 of the RI Standard Specifications for Road and Bridge Construction.

SECTION 903

FENCES - SPLIT RAIL FENCE AND GATE

903.01 DESCRIPTION.

903.01.2 Split Rail Fence. This work consists of constructing split rail fencing and gates, including posts, post foundations and all necessary hardware in close conformity with contract documents and/or as directed by the Engineer, all in accordance with these Specifications.

903.02 MATERIALS.

903.02.2 Split Rail Fence. Materials for split rail wood fences, gates, posts, and all related hardware shall conform to the applicable requirements of **Subsections M.08.04 and M.08.06** of these specifications. The type of wood to be utilized for fencing, including gates and posts, shall be as specified in the contract documents and conform to AASHTO M168. Timber preservatives, when specified, shall conform to AASHTO M133.

903.03 CONSTRUCTION METHODS.

903.03.8 Split Rail Fence. Split Rail Fencing, including the placement and spacing of posts, shall be installed at the locations shown on the plans or as directed by the Engineer. Posts shall be set plumb at a minimum depth of 3'-0" in concrete footings or in holes backfilled and compacted, and shall be set in alignment with horizontal rail elements in accordance with the dimensions shown on the plans.

903.04 METHOD OF MEASUREMENT.

903.04.5 Split Rail Fence and Gate. "Split Rail Fence" will be measured in Linear Feet along the top of fence between post centerlines, for sections actually installed in accordance with the provisions of contract and/or as directed by the Engineer.

"Split Rail Gate" will be measured by the number of such units actually installed in accordance with the provisions of contract and/or as directed by the Engineer.

903.05 BASIS OF PAYMENT.

903.05.5 Split Rail Fence and Gate. "Split Rail Fence" will be paid for at the respective unit price per linear foot as listed in the Proposal. The price so stated shall constitute full and complete compensation for all labor, material, tools, equipment and all incidentals required to complete the work, complete and accepted by the Engineer.

"Split Rail Gate" will be paid for at the respective unit price per each as listed in the Proposal. The price so stated shall constitute full and complete compensation for all labor, material, tools, equipment and incidentals required to finish the work, complete and accepted by the Engineer.

Remove **Section 918; Rural Mailboxes Postmaster Approved,** page AC14-19 of the August 2013 Compilation of Approved Specifications and replace it with the following.

SECTION 918

RURAL MAIL BOXES POSTMASTER APPROVED

918.01 DESCRIPTION. This work consists of replacing existing rural mail boxes with new 2-door mail boxes when the existing mail boxes do not conform to the specifications of the U.S. Postal Service and/or local requirements, all in accordance with these Specifications.

918.02 MATERIALS. New rural mail boxes shall conform to the standards established by the U.S. Postal Service for materials, coatings, and paint. The doors of the new mail boxes must have embossed thereon the following inscriptions: "U.S. MAIL," and "APPROVED BY THE POSTMASTER GENERAL." Identification in the form of a house, apartment or box number, clearly visible to the mail carrier's approach and consistent with USPS Standards, shall be provided.

918.03 CONSTRUCTION METHODS. Mounting of new rural mail boxes on posts shall conform to the requirements of **Subsection 917.03.2, Para. c; Mounting of Mail Boxes**, of these Specifications.

918.04 METHOD OF MEASUREMENT. "Rural Mail Boxes" of the various types indicated on the Plans will be measured by the number of such boxes actually installed in accordance with the Plans and/or as directed by the Engineer.

918.05 BASIS OF PAYMENT. The accepted quantities of "Rural Mail Boxes" of the various types indicated on the Plans will be paid for at their respective contract unit prices per each such box as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, materials and equipment, including removal of existing rural mail boxes, hardware and incidentals required to finish the work, complete and accepted by the Engineer.

Revise **Section M.05; Metals**, pages M-23 through M-30 of the RI Standard Specifications for Road and Bridge Construction as follows.

SECTION M.05

METALS

- **Replace Subsection M.05.01; Bar Reinforcement in its entirety with the following.**

M.05.01 BAR REINFORCEMENT. All reinforcement shall be furnished as indicated on the Plans. Reinforcing bars shall be deformed and be fabricated from new billet steel and shall conform to AASHTO M31 (ASTM A615) or ASTM A706. The grade shall be 60 unless otherwise shown on the Plans.

- **Replace Subsection M.05.04.6; Shear Connectors in its entirety with the following.**

M.05.04.6 Shear Connectors. Shear connector studs shall conform to the requirements of the Specification for Cold Finished Carbon Steel Bars and Shafting, AASHTO M169 (ASTM A108) cold-drawn bar, Grade 1018 or Grade 1020, either semi- or fully-killed. If flux-retaining caps are used, the steel for the caps shall be of a low carbon grade suitable for welding and shall comply with Cold-Rolled Carbon Steel Strip, ASTM A109.

Tensile properties as determined by tests of bar stock after drawing or of finished studs shall conform to the following requirements:

Tensile Strength (min.)	60,000 psi
Yield Strength* (min.)	50,000 psi
Elongation (min.)	20 percent in 2 inches
Reduction of area (min.)	50 percent

*As determined by a 0.2 percent offset method.

Tensile properties shall be determined in accordance with the applicable sections of ASTM A370, Mechanical Testing of Steel Products. Tensile tests of finished studs shall be made on studs welded to test plates using a test fixture similar to that shown in Figure 7.2 of the current ANSI/AASHTO/AWS D1.5 Bridge Welding Code. If fracture occurs outside of the middle half of the gauge length, the test shall be repeated.

Finished studs shall be of uniform quality and condition, free from injurious laps, fins seams, cracks, twists, bends, or other defects. Finish shall be as produced by cold drawing, cold rolling, or machining.

a. Certification. The manufacturer shall certify that the studs, as delivered, are in accordance with the material requirements of this Section. Certified copies of in-plant quality control test reports shall be furnished to the Engineer upon request.

b. Acceptance Samples. The Engineer may select at the Contractor's expense, studs of each type and size used under the Contract, as necessary for checking the requirements of this Section.

- **Replace Subsection M.05.05; Epoxy Coating for Bar Reinforcement in its entirety with the following.**

M.05.05 GALVANIZING FOR BAR REINFORCEMENT. The bar reinforcement shall be Class 1 galvanized after bar fabrication, in accordance with ASTM A767, Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement, including Supplemental Requirements S1 and S3.

In accordance with ASTM A767, the average coating thickness, of a minimum of 3 tests, shall be 3.5 oz/sf or 6 mils.

Chromating is not allowed.

Prior to galvanizing, the material shall have all grease, dirt, mortar, mill scale, injurious rust, or any other foreign substance removed.

For the purpose of these specifications, the term "injurious rust" shall be interpreted to mean rust which is not firmly bonded to the steel. Rust which is difficult to remove, even by vigorous scrubbing with a wire brush, shall be considered firmly bonded to the steel.

The galvanized threads of nuts and mechanical connectors used for assembly with galvanized bolts and reinforcement shall be tapped oversize prior to coating and need not be retapped afterwards. The minimum additional diameter for Class-2A threads galvanized to Class C is as follows:

Class-2A Thread Diameter (in.)	Additional Diameter (in.)*
7/16" and smaller:	0.016"
Over 7/16" to 1":	0.021"
Over 1":	0.031"

* applies to both pitch and minor (root) diameters, minimum and maximum limits.

Material galvanized in accordance with these specifications shall be free from any buildup of unadhered wet storage stains (white rust). These corrosion deposits, if present, shall be removed in a manner satisfactory to the Engineer prior to incorporation of the material in the work. After removal of these deposits, the coating shall have a uniform appearance free from uncoated spots, lumps, blisters, gritty areas, acid flux and black spots. Materials with these defects, or not meeting the finish and adherence of coating requirements as defined in the above ASTM specification, will be rejected and shall be immediately removed from the work site. Acceptable material shall be provided to replace rejected material at no additional cost to the State.

Zinc-Rich Paint. Zinc-rich paint used for the field application and repair of galvanized coatings shall meet the following requirements:

A. One application of the material shall provide a dry coating thickness of at least 2.0 mils.
B. The applied coating shall provide barrier protection and shall be anodic to steel.
C. Application of the coating material shall be possible under shop or field conditions.
D. The dried film shall have a minimum zinc dust content equal to 94% (by weight).

E. The brand of material used shall be approved by the galvanizer, and shall be compatible with the galvanizing, and inert in concrete.

Miscellaneous Hardware - Chairs, tie wires, nuts, bolts, washers, other devices, and miscellaneous hardware used to support, position, or fasten the reinforcement shall be made of or coated with, a non-conducting material, or galvanized. The specific hardware that the Contractor proposes to use shall be approved by the Engineer. If the specific hardware is galvanized, the hardware shall be prepared and galvanized in accordance with the requirements of both AASHTO M232 (ASTM A153) and this specification The deflection of the hardware used to support the reinforcing bar mat shall not exceed ten percent of the specified concrete clear cover.

Mechanical Couplers. Mechanical couplers shall be on the RIDOT Approved Products list or submitted to the Engineer for approval a minimum of 15 working days prior to their use. They shall be sized to fit the reinforcing bar to be spliced and designed such that the splice connection shall meet or exceed 125% of the specified yield strength of the rebar.

- **Replace Subsection M.05.06; Galvanizing in its entirety with the following.**

M.05.06 GALVANIZING. Structural steel shall be galvanized in accordance with the Specifications for Zinc (Hot-dip-Galvanized) Coatings on iron and steel products, AASHTO M111 (ASTM A123). Fasteners and hardware items shall be galvanized in accordance with the specifications for Zinc Coating (Hot-dip) on Iron and Steel Hardware, AASHTO M232 (ASTM A153) except that high strength fasteners shall not be galvanized if hydrogen embrittlement can occur. Corrosion protection for these fasteners shall be per **Subsection 825.03.3(c)**.

- **Replace Subsection M.05.07.3; Wire in its entirety with the following.**

M.05.07.3 Wire. The wire used for spraying required herein shall be pure zinc or an alloy consisting of 85 percent zinc and 15 percent aluminum by weight drawn to manufacturer's recommendation for compatibility with equipment being used. The chemical composition shall be in accordance with ASTM B833.

Remove **Section M.06; Paint,** pages M-31 and M-32 of the RI Standard Specifications for Road and Bridge Construction and AC-151 through AC-154 of the January 2011 Compilation of Approved Specifications in its entirety and replace it with the following.

SECTION M.06

PAINT

M.06.01 GENERAL. Obtain certification from the coating manufacturer that all paint materials satisfy composition and testing requirements, are in conformance with the approved qualified products or other applicable requirements, and will not exceed the manufacturer's specified shelf life before use.

Materials will be rejected if the material arrives at the application site in containers other than original, unopened containers; if a container has a break in the lid seal or a puncture; or if the coating materials have started to polymerize, solidify, gel, or deteriorate in any manner.

There shall be no noticeable difference in color between batches of finish paint used on an individual structure, as defined herein: The tri-stimulus color value shall be no greater than a ΔE (color difference) of 2. The Volatile Organic Content (VOC) shall comply with prevailing federal and state regulations.

M.06.01.1 Material Certification.

Test Data: Have the coating manufacturer or an approved laboratory test a sample from each production batch and forward the results to the Resident Engineer. Provide the following test data for each of the coating material components (primer, intermediate and topcoats):

- Infrared spectra (2.5 μm to 15 μm (2.5 to 15 microns))
- Mass per liter (weight per gallon), at 25°C (77F)
- Viscosity in Krebs Units, at 25°C (77F)
- Percent solids by mass (weight)

M.06.01.2 Literature. Product data sheets shall be supplied with each of the products and shall include but not be limited to the following information:

a. Basic Description. Generic type, recommended service environment/use, recommended substrates, recommended surface preparation, recommended compatible coatings and recommended thinners.

b. Physical Characteristics and Performance. Solids by volume of the mixed components, recommended thickness per coat, weathering ability, minimum and maximum recoat interval and cure requirements, per the applicable ASTM standards.

c. Application Instructions. Mixing instructions, pot life for catalyzed materials, temperature and humidity application limitations, instructions for application by spray including equipment recommendations, cleanup recommendations, and storage conditions.

d. Solvent Identification Sheets. Solvent Identification Sheets shall indicate a listing of the volatile portions of vehicle and categorize solvents by type and photochemical reactivity.

e. Product Certification. Certificates of Compliance shall be provided for materials used to meet State Department of Transportation Specifications.

f. Safety Data Sheets. Safety Data Sheets (SDS) shall be provided to the Contractor and Engineer and shall accompany all shipped materials so the person receiving the material is aware of storage requirements and of the hazards presented by the products. Additional copies of the SDS shall be made available upon request.

M.06.01.3 Shipping and Delivery. All paint shall be delivered to the shop or jobsite in their original containers, unopened, and with labels intact.

All coating layers in the Paint system shall be supplied by the same manufacturer.

The Contractor/fabricator shall ensure that sufficient quantities of paint are ordered. All topcoat material shall be supplied from the same lot or batch number.

Unless otherwise specified, all paint furnished shall be delivered in metal containers that are U.S. Standard 5 (five) gallon size or the similar metric equivalent. One gallon containers may be used for small quantities only for touch-up or spot maintenance work.

All containers shall be labeled in accordance with ANSI Z129.1-2000 "Hazardous Industrial Chemicals- Precautionary Labeling"

The following information shall be listed in clear, legible type on the label of each container for each product:

- Manufacturer's name and complete address

- Product name including component type, if applicable

- Color name or number of the particular product or component

- The lot and/or batch number of the product and components

- The date of manufacture of the product and components

- Identification of any toxic substances contained in the product.

M.06.01.4 Sampling. Samples will be randomly selected by the Engineer from the stockpile of material proposed for the work, from each production batch represented by the project stockpile. A production batch is defined as one distinct, identifiable unit of production of material outlined in the manufacturer's quality control plan. The Contractor shall properly mix the contents of each paint component to be sampled by the Engineer, per the manufacturer's recommendations, immediately prior to sampling. The Engineer reserves the right to sample any container of paint material on the job site. No paint shall be applied until the batch sample has been approved by the Engineer. After the samples have been collected, the remainder may be used for the project work, providing the samples pass the testing requirements and are stored prior to use in accordance with the manufacturer's recommendations.

M.06.02 PAINT SYSTEMS. The paint shall be selected from either the NEPCOAT Qualified Products List or as otherwise described in this specification.

M.06.02.1 New or 100% Bare Existing Structural Steel and/or Hardware. Paint systems on the NEPCOAT Qualified Products List are required for new or 100% bare structural steel and any related hardware. Surface preparation shall be per the recommended (not minimum) method as recommended by the manufacturer. Steel that is galvanized or metalized shall omit the specified zinc rich primer. The intermediate and finish coats of NEPCOAT systems shall be used to overcoat galvanizing or metalizing. If the galvanizing or metalizing is damaged, the approved organic zinc-rich primer from the NEPCOAT Qualified Products List for the system shall be applied before applying the intermediate and topcoat.

M.06.02.3 Existing Steel Structures and/or Hardware. This shall apply whenever the surface has been previously coated and/or has rusted, when minimal surface preparation has been specified by the Engineer or requested by the Contractor and approved by the Engineer. The coating system used shall be on the NEPCOAT Qualified Products List, except the zinc rich primer shall be replaced by a surface tolerant product from the same manufacturer and compatible with the coating to be applied over it. The coating system shall be submitted for approval prior to the start of any work. Surface preparation shall be per the manufacturer-recommended (not minimum) method, unless otherwise approved by the Engineer.

M.06.03 CAULKING AND SEALANTS. Supply caulking and sealants that are compatible with the coating system specified for the project. Provide written confirmation from the coating and caulking/sealant manufacturers that the caulking and sealant products are compatible. The color of the caulking or sealants shall be the same as the finish coat color or clear, as approved by the Engineer.

Remove **Section M.12; Waterproofing, Dampproofing and Sealers,** pages M-45 through M-49 of the RI Standard Specifications for Road and Bridge Construction and AC11-20 of the May 2011 Compilation of Approved Specifications and replace it with the following.

SECTION M.12

WATERPROOFING, DAMPPROOFING AND SEALERS (CONCRETE PROTECTIVE SYSTEMS)

M.12.01 DAMPPROOFING. Products shall be on the RIDOT Approved Products List

M.12.01.1 Primer shall be as required by the manufacturer,

M.12.01.2 Mop Coats shall conform to ASTM D449.

M.12.02 WATERPROOFING. Products shall be on the RIDOT Approved Products List

M.12.02.1 Hot Applied Liquid Membrane.

a. Surface Conditioner shall be as required by the manufacturer,

b. Waterproof Membrane shall be a single component, hot-applied, rubberized asphalt capable of being applied at a uniform thickness at an application temperature within the range recommended by the manufacturer. After cooling, it shall form a tough, monolithic, flexible membrane, continuously bonded to all concrete surfaces, and meeting the following physical properties.

Test	Method	Required Results
Flash Point	Open Cup	510°F (265°C) min
Water Vapor Transmission	ASTM E96 Vapor transmitted in 24 hrs. gr/hr sq. ft. (g/hr sq. m)	At 77°F (25°C) 0.010 gr.(0.07 g) min At 120°F (49°C) 0.016 gr. (0.11 g) min
Water Vapor Permeability	ASTM E96	0.01 perms max. (0.0066 m perms)
Water Resistance	ASTM D1167 Submerged 96 hours at 120°F (50°C)	No blistering No emulsification No deterioration
Water Absorption	Change of mass of coating 3.94x3.94 in. (100x100 mm) applied to glass substrate immersed in water at 120°F (50°C) for 96 hours	Max loss 1.323 gr. (0.189g) Max gain 2.513 gr. (0.359g)

Test	Method	Required Results
Penetration by Standard Cone	ASTM T187	At 32°F (0°C) less than 35 (1/10 mm) At 77°F (25°C) less than 110 (1/10mm At 120°F (49°C) less than 200 (1/10mm
Flow	AASHTO T187 coating bent 75° exposed for 5 hours	At 120°F (49°C) none At 140°F (60°C) 1/8" (3.2 mm) Max.
Low Temperature Flexibility	1/8" (3.2 cm) coating on alum. bent 90 over 1/4" dia. mandrel	No delamination, No cracking At -15°F (-26°C)
Adhesion	1/8" (3.2 cm) coating on alum. bent 90 over 1/4" dia. mandrel	No adhesion failure At -15°F (-26°C)
Heat Aging	Wt. loss in 28 days at 190°F (88°C)	Less than 1%
Elasticity	Reaction to sudden elongation	Min. toughness of 25 in./lbs. (29 cm/kg) 20 in/min (50.8 cm/min)
Toughness (Joules) Ratio of Toughness to Peak Load	AASHTO T187 Ratio of Toughness ft lbs (Joules) to Peak Load pounds (Newtons)	Not less than 4.1 ft lbs (5.5 J) Not less than 0.040
Crack Bridging Capability	3.0± 0.2mm thick film, tested at -25°C with a crack opening of 3.0± 0.2mm opening rate of 3.0± 0.2mm/h for 10 cycles	No cracking No splitting No loss of adhesion
Heat Stability	Held for 5 hours at recommended application temperature	Shall meet penetration flow, low temperature flexibility and viscosity requirement
Viscosity	Heated to recommended application temperature	Range 2 to 15 sec

c. Protective Covering shall be per the manufacturer's recommendations. The protective sheets shall be free from visible external defects such as holes, ragged or untrue edges, breaks, cracks, tears, protuberances or indentations.

M.12.02.2 Preformed Membranes. The waterproofing membrane shall be provided in rolled sheet form. One face of the membrane shall be adhesive and protected with an easily removable coated backing paper to prevent adhesion of the membrane to itself. The membrane shall be composed of rubberized or polymer modified asphalt, reinforced with a fiberglass or polypropylene mesh or approved equivalent.

a. Primer shall be as specified by the membrane manufacturer.

b. Sheet Membrane shall conform to the following specifications.

Test	**Method**	**Required Result**
Thickness	-	60 mils (± 5 mils)
Tensile Strength	Per ASTM D882	50 lbs./in. (88 N/cm) min
Pliability	Per ASTM D146\ At -15°F (-26°C) with 1" (25.4 mm) mandrel	25% elongation, min No cracks or splits
Puncture Resistance	ASTM E154	200 lbs. (890 N) min.
Permeance	ASTM E96	0.1 perms (0.066 m perms), max.

M.12.02.3 Torch-applied Pre-fabricated Membrane. Primer: The primer shall allow the quick application of the prefabricated waterproofing sheet membrane and shall be as specified by the manufacturer of the membrane.

Sheet Membrane: The membrane material shall consist of a prefabricated reinforcement of synthetic nonwoven material, thoroughly impregnated and coated with styrene-butadiene-styrene (SBS) modified bitumen. It shall be provided in rolled sheet form.

Curb bitumen shall be an SBS modified liquid bitumen that conforms to the following tests:

Test	**Method**	**Required Result**
Softening Point	ASTM D-2398	Penetration at 77°F
Penetration at 77°F		
Tensile strength	UEAtc	100 lbs. /in min (170N/cm min)

Low Temperature Flexibility	Appearance of the membrane lower face after bending at 5°F (-15°C)	No damage
Puncture Resistance	ASTM-E154	315 lbs. (1400 N) min 1 ½ in. (40mm min)
Softening Point	ASTM-D36	≥ 150°C

M.12.02.4 Cold Applied Liquid Membrane.

a. Primer. Primer shall be a 100-percent reactive, monomer or polymer-based, two-component resin.

b. Membrane. The coating system shall be a spray applied, 100% solids, fast cure, high build monomer or polymer system. Primer is required. The membrane system shall pass ASTM C 836 Crack Bridging Test at 80 mils, or the thickness applied shall be at least equal to the thickness used by the manufacturer for the ASTM C 836 Crack Bridging Test. Apply aggregate broadcast into membrane applied at 30 – 40 mils if conditions warrant. A manufacturer-approved tack coat shall be included for overlays on the waterproofing membrane. In addition the membrane shall meet or exceed the following properties, submitted with a Certificate of Compliance, as related to laboratory prepared samples.

Test Method Required Results

Test	**Method**	**Required Results**
Initial Cure Time	N/A	30 Minutes, 73°F 50-85% RH
Water Vapor Transmission	ASTM E 96	0.026 gr./ft^2/hr (0.18 g/m^2/hr)
Adhesion to Concrete	ASTM D 4541	>100 psi
Adhesion to Steel	ASTM D 4541	>290 psi
Tensile Strength, Method A, Die C	ASTM D 638	>435 psi
Elongation at Break, Method A, Die C	ASTM D 638	>100%
Low Temperature	¼“ (6.35mm) mandrel @ -13°F (-25°C)	Pass
Crack Bridging	ASTM C 836	Pass @ 10 cycles, 0.0625 in, -15°F (1.6mm, -26°C)

M.12.03 CONCRETE PROTECTIVE SEALERS. All material is subject to the approval of the Engineer, shall have been tested and approved by the Engineer prior to the start of application and shall conform to the following requirements.

a. Shall meet all current Federal and State environmental regulations.

b. Shall not contain oxidizing ingredients such as marine oils, stearates and vegetable oils.

c. Shall reduce the chloride intrusion into concrete by 90 percent when tested in accordance with AASHTO T259 "Resistance of Concrete to Chloride Ion Penetration" or by 55 percent when tested in accordance with RIDOT Materials Laboratory Test "Chloride Penetration Resistance of Concrete Sealers" as described in research report FHWA-RI-RD-90-1 "Laboratory Evaluation of Concrete Sealers for Vertical Highway Structures."

d. Shall reduce the net moisture weight gain of concrete after drying to 30 percent or less as tested in accordance with RIDOT Materials Laboratory Test "Water Absorption and Water Vapor Transmission of Concrete Sealers," as described in RIDOT research report FHWA-RI-RD-90-1 "Laboratory Evaluation of Concrete Sealers for Vertical Highway Structures."

e. Shall provide effective freeze-thaw protection to the underlying concrete as tested in accordance with ASTM C666; "Resistance of Concrete to Rapid Freezing and Thawing," as modified by RIDOT for coated specimens, as described in RIDOT research report FHWA-RI-RD-90-1 "Laboratory Evaluation of Concrete Sealers for Vertical Highway Structures."

f. Shall be applied in a minimum of two coats, unless otherwise recommended by the manufacturer.

g. Shall be used as recommended by the manufacturer. It shall not be diluted or altered in any way.

h. At least 2 weeks prior to the start of application a one gallon sample of the product and all pertinent information including but not limited to, manufacturer's protective coating test results shall be submitted to the Engineer by the manufacturer.

M.12.03.1 Film Forming Sealers shall form a durable, impermeable surface coat over the concrete substrate, and shall conform to the following.

a. Shall be a formulation which, when set, is weatherproof, waterproof, resistant to most chemicals, inhibits the intrusion of chloride salts and has exceptionally strong adhesive qualities.

b. Shall, in the case of two-component coatings, be shipped in new containers identified Part "A" and Part "B," and shall be proportioned in each container to provide the manufacturer's specified mixing ratio.

c. Shall be applied to concrete median barriers in alternating coats of "light gray" and "white" with the top coat being "white." For structural concrete, the material shall be applied in alternating coats of "white" and "light gray" with the top coat being "light gray." The material shall be applied so that it completely covers the underlying coat.

M.12.03.2 Penetrant Class Sealers shall penetrate the surface of the concrete substrate and leave no visible trace of its presence.

Remove **Subsection M.15.06.1; Light Standards,** pages AC14-21 and AC14-22 of the August 2013 Compilation of Approved Specifications in its entirety and replace it with the following:

M.15.06.1

LIGHT STANDARDS

M.15.06 LIGHT STANDARDS AND FOUNDATIONS.

M.15.06.1 Light Standards. Poles are to be designed for a basic wind speed of 130 miles per hour with 1.14 gust factor with loading in accordance with the latest revision of the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals.

All non-rounded luminaires and high level lighting structures, as defined in the latest revision of the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals on Interstate Highways or limited access type facilities must comply with fatigue Category I requirements, including galloping, vortex shedding (if applicable), natural wind gusts, and truck induced gusts. The truck induced loading shall be based on 65 mph velocity.

All non-rounded luminaires and high level lighting structures on all other roadways must comply with fatigue Category II requirements, including galloping, vortex shedding (if applicable), natural winds gusts, and truck induced gusts. The truck induced loading shall be based on 30 mph velocity.

Lighting structures that have a taper of 0.14 inch per foot or greater are not susceptible to vortex shedding.

Structural components and their connections shall be designed to resist the worst-case fatigue loading, upon evaluation of all applicable cases acting separately.

The design of anchor bolts shall result in a ductile steel failure prior to any sudden brittle failure of the concrete.

The breakaway support couplings shall meet the requirements of the latest revision of the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals.

Design and fabrication of aluminum lighting standards for the support of high pressure sodium luminaires shall be similar and compatible in design and appearance with lighting standards installed on various sections of Interstate highways in the State of Rhode Island, except as otherwise noted or indicated on the Plans. The nominal luminaire mounting heights shall be 30 and 40 feet.

Each shaft shall be tempered by a cold working process from a seamless extruded tube of 6063-T6 or 6005-T5 wrought-aluminum alloy. The davit arm shall taper from 6 inches at the base to 4 inches at the tip.

A 2-inch diameter slip fitter, 9 inches long, shall be provided at the end of each davit arm.

All arms shall be curved on an approved radius through an angle within 3 degrees of the horizontal. Twin davit lighting standards shall be provided with approved type field joints. The bottom of the bases shall be coated with bituminous paint after assembly.

The base shall be of 356-T4 permanent mold cast aluminum alloy. The base shall be approximately 12 inches square at the bottom with a height of 3½-inches. Welding shall be performed by the inert gas shielding arc method, and welds shall be free from cracks and porosity. The base shall have slotted anchor bolt holes to allow mounting on 11-inch or 12-inch bolt circles. Bases shall be provided with cast aluminum bolt covers.

The aluminum after fabrication shall have a minimum yield limit of 25,000 pounds per square inch. The shaft shall be capable of withstanding 1,500-pound horizontal load 18 inches down from the top without fracture or apparent permanent deformation after the load has been released. The base shall be capable of withstanding the maximum allowable bending moment of the shaft, but not less than 18,500 foot-pounds.

When the arm is welded to the shaft, the arm shall withstand a vertical load of 100 pounds and a horizontal load of 50 pounds applied at the end of the arm without fracture or permanent deformation after the load has been removed.