RHODE ISLAND

DEPARTMENT
OF
TRANSPORTATION

Standard Specifications
for
Road and Bridge Construction

AMENDED AUGUST 2013

PREFACE

This 2004 edition of the Rhode Island Department of Transportation Standard Specifications for Road and Bridge Construction is to be used on all contract work awarded by the Rhode Island Department of Transportation, and may also be incorporated by reference in contract work on local, secondary or urban systems and on other contract work in which the Department has an interest. These Specifications replace the 1997 edition of the Standard Specifications and all Compilations, Supplemental Specifications and other revisions, modifications and updates to the 1997 edition for all contracts awarded by the Department subsequent to the publication of this 2004 edition.

These Specifications shall control the work on all Rhode Island Department of Transportation construction contracts except where modified by Supplemental Specifications or the contract Special Provisions. In the event of conflict between the contract provisions and these Specifications, the contract provisions shall govern.

Copies of this publication may be obtained from:

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This publication is also available on Compact Disk (CD-ROM) in Adobe Acrobat format, and may be accessed on the Department of Transportation's website at:

www.dot.state.ri.us

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TABLE OF CONTENTS

DIVISION I

Page

PART 100 GENERAL REQUIREMENTS AND COVENANTS

Section 101 Definitions and Terms 1-1
Section 102 Bidding Requirements and Conditions 1-10
102.01 Prequalification of Bidders 1-10
102.02 Contents of Proposal Forms 1-10
102.03 Interpretation of Quantities in Bid Schedule 1-11
102.04 Examination of Plans, Specifications, Special Provisions and Site of Work 1-11
102.05 Preparation of Proposal 1-11
102.06 Proposal Guaranty 1-12
102.07 Irregular Proposals 1-12
102.08 Delivery of Proposals 1-14
102.09 Withdrawal or Revisions of Proposals 1-14
102.10 Combination or Conditional Proposals 1-14
102.11 Public Opening of Proposals 1-14
102.12 Disqualification of Bidders and Rejection of Proposals 1-14
102.13 Material Guaranty 1-15
102.14 Bidding Certifications 1-16
Section 103 Award and Execution of the Contract 1-18
103.01 Consideration of Proposals 1-18
103.02 Post Qualification Requirements and Award of Contract 1-18
103.03 Cancellation of Award 1-19
103.04 Return of Proposal Guaranty 1-19
103.05 Contract Bond 1-19
103.06 Execution and Approval of the Contract 1-20
103.07 Failure to Execute Contract 1-20
103.08 Escrow of Bid Documentation 1-20
Section 104 Scope of Work 1-22
104.01 Intent of Contract 1-22
104.02 Changes in the Contract 1-22
104.03 Differing Site Conditions 1-22
104.04 Alterations in the Plans or Details 1-23
104.05 Extra Work 1-23
104.06 Suspension of Work Ordered by the Engineer 1-23
104.07 Significant Changes in the Character of the Work 1-24
104.08 Maintenance of Traffic 1-24
104.09 Maintenance of Public Access 1-26
104.10 Rights In and Use of Materials Found on the Project 1-26
104.11 Final Cleaning-Up 1-26
104.12 Railway – Highway Provisions 1-27
104.13 Construction Over or Adjacent to Navigable Waters 1-27
104.14 Contractor's Responsibility for the Work 1-27
104.15 Environmental Protection 1-27

PART 100 GENERAL REQUIREMENTS AND COVENANTS (Continued) **Page**

Section105 Control of Work 1-28
105.01 Authority of the Engineer 1-28
105.02 Plans and Shop Drawings 1-28
105.03 Conformity with Plans and Specifications 1-29
105.04 Coordination of Plans, Specifications, Supplemental Specifications and Special Provisions 1-29
105.05 Cooperation by Contractor 1-30
105.06 Cooperation with Utilities 1-30
105.07 Cooperation Between Contractors 1-32
105.08 Construction Stakes, Lines and Grades 1-33
105.09 Authority and Duties of Resident Engineer 1-33
105.10 Inspection of Work 1-33
105.11 Removal of Unacceptable and Unauthorized Work 1-34
105.12 Load Restrictions 1-34
105.13 Maintenance During Construction 1-34
105.14 Opening Sections of Project to Traffic 1-35
105.15 Furnishing Right-of-Way 1-35
105.16 Failure to Maintain Roadway or Structure 1-35
105.17 Acceptance 1-36
105.18 Claims for Adjustments and Disputes 1-37
105.19 Procedures for Claims and Disputes 1-40
105.20 Project Delays 1-40
105.21 Work Zone Training 1-41
Section 106 Control of Material 1-41
106.01 Source of Supply and Quality Requirements 1-41
106.02 Local Material Sources 1-42
106.03 Samples, Tests, Cited Specifications 1-43
106.04 Certification of Compliance 1-43
106.05 Plant Inspection 1-44
106.06 Storage of Materials 1-44
106.07 Handling of Materials 1-45
106.08 Unacceptable Materials 1-45
106.09 Department-Furnished Materials 1-45
Section 107 Legal Relations and Responsibility to Public 1-45
107.01 Laws to be Observed 1-45
107.02 Specific Statutes Required to be Inserted 1-46
107.03 Permits, Licenses and Taxes 1-48
107.04 Patented Devices, Materials and Processes 1-48
107.05 Restoration of Surfaces Opened by Permit 1-49
107.06 Federal-Aid Participation 1-49
107.07 Sanitary, Health and Safety Provisions 1-49
107.08 Public Convenience and Safety 1-49
107.09 Barricades and Warning Signs 1-50
107.10 Use of Explosives 1-50
107.11 Protection and Restoration of Property and Landscape 1-52
107.12 Forest Protection 1-53
107.13 Responsibility for Damage Claims 1-53

PART 100 GENERAL REQUIREMENTS AND COVENANTS (Continued) **Page**

107.14 Third Party Beneficiary Clause 1-55
107.15 Personal Liability of Department Employees 1-55
107.16 No Waiver of Legal Rights 1-55
107.17 Hazardous Materials 1-55
107.18 Civil Rights 1-56
Section 108 Prosecution and Progress 1-56
108.01 Subletting of Contract 1-56
108.02 Notice to Proceed 1-56
108.03 Prosecution and Progress 1-56
108.04 Limitation of Operations 1-69
108.05 Character of Workers 1-69
108.06 Methods and Equipment 1-69
108.07 Determination of Contract Time 1-70
108.08 Failure to Complete on Time 1-71
108.09 Default of Contract 1-72
108.10 Termination of Contract 1-74
Section 109 Measurement and Payment 1-77
109.01 Measurement of Quantities 1-77
109.02 Scope of Payment 1-79
109.03 Compensation for Altered Quantities 1-80
109.04 Differing Site Conditions, Changes, Extra Work
And Force Account Work 1-80
109.05 Eliminated Items 1-82
109.06 Partial Payments 1-83
109.07 Partial Payment of Lump Sum Items 1-84
109.08 Payment of Withheld Funds 1-84
109.09 Acceptance and Final Payment 1-84
109.10 Compensation for Project Delays 1-85
109.11 Prompt Payment Procedures 1-86
109.12 Subcontractor Prompt Payment 1-86

DIVISION II CONSTRUCTION DETAILS

PART 200 EARTHWORK AND EROSION CONTROL

Section 201 Site Preparation 2-1
Section 202 Excavation and Embankment 2-11
Section 203 Structure Excavation and Backfill 2-22
Section 204 Trimming and Fine Grading 2-29
Section 205 Trench Excavation 2-32
Section 206 Perimeter Erosion Controls..... 2-37
Section 207 Check Dams 2-40
Section 208 Temporary Dewatering Basins 2-43
Section 209 Storm Drain Protection 2-46

PART 200 EARTHWORK AND EROSION CONTROL (Continued) **Page**

Section 210 Stilling Basins for Water Pollution Control 2-49
Section 211 Construction Accesses 2-50
Section 212 Maintenance and Cleaning of Erosion and Pollution Controls 2-51
Section 213 Placement of Millings Beneath Guardrail 2-55
Section 214 Containment System for Control of Hydrodemolition Runoff and Maintenance and Disposal of Hydrodemolition Runoff 2-56

PART 300 AGGREGATE AND GRAVEL BASE AND SUBBASE COURSES

Section 301 Aggregate and Gravel Base Courses 3-1
Section 302 Gravel Borrow Subbase Courses 3-2
Section 303 Special Graded Aggregate for Shaping and Trimming Driveways or Shoulders 3-2
Section 304 Selected Leveling and Filler Aggregate 3-4

PART 400 BITUMINOUS PAVEMENTS

Section 401 Dense Graded Bituminous Concrete Pavements 4-1
Section 402 Friction Course 4-20
Section 403 Asphalt Emulsion Tack Coat 4-23
Section 404 Prime Coat 4-24
Section 405 Seal Coat 4-26
Section 406 Cold Recycled Base Course (Pavement Rehabilitation/Recycling) 4-29
Section 407 Hot Recycle Option for Bituminous Pavements 4-31
Section 408 Cleaning, Routing and Sealing Cracks in Bituminous Concrete Pavements 4-35
Section 409 Sawing and Sealing Transverse Joints in Bituminous Concrete Pavements Over Rigid Base 4-37
Section 410 Temporary Patching Material, Potholes and Trenches 4-39

PART 500 CONCRETE PAVEMENTS

Section 501 Portland Cement Concrete Pavement and Base 5-1
Section 502 Full Depth Cleaning and Sealing of Joints And Cracks Two and One-Half (2½) Inches Nominal Width or Less in Portland Cement Concrete Pavement 5-13

PART 500 CONCRETE PAVEMENTS (Continued) **Page**

Section 503 Repairing Deteriorated/Damaged Joints Greater Than Two and One-Half (2½) Inches and Less Than or Equal to Eight (8) Inches Nominal Width in Finished Portland Cement Concrete Pavement …….. 5-15
Section 504 Pavement Grooving ……. 5-18
Section 505 Portland Cement Concrete Base Course w/Crack Control – 8-Inch Extra Strength ……. 5-19

PART 600 CONCRETE

Section 601 Portland Cement Concrete ……. 6-1
Section 602 Mineral Additives for Portland Cement Concrete …….. 6-26
Section 603 Controlled Low Strength Material (CLSM) …….. 6-28
Section 604 Class HP(AE) Portland Cement Concrete ……..... 6-32
Section 605 Concrete with Calcium Nitrite Based Corrosion Inhibitor …….. 6-34

PART 700 DRAINAGE AND EROSION CONTROL

Section 701 Culverts and Storm Drains ……. 7-1
Section 702 Manholes, Inlets and Catch Basins …….....……. 7-7
Section 703 Underdrains and Combination Drains ……..…. 7-11
Section 704 Reconstruct Catch Basins and Manholes ……. 7-13
Section 705 Reconstruct Existing Type “D” Catch Basin To Catch Basin with Gutter Inlet …….. 7-14
Section 706 Plug and Cap Pipe – All Sizes …….. 7-15
Section 707 Adjust Drainage and Utility Structures …….. 7-16
Section 708 Cleaning and Flushing Pipes and Drainage Structures ……. 7-17
Section 709 Concrete for Thrust Blocks, Headwalls and Miscellaneous Purposes …….. 7-19
Section 710 Cut Ins for Manholes, Catch Basins and Pipe ……. 7-20
Section 711 Paved Waterways …….…….…… 7-21
Section 712 Water and Gas Gate Boxes ……. 7-23
Section 713 Adjust Curb Stop, Water Gate and Gas Gate Boxes ……...…… 7-25
Section 714 Post Type Hydrants ……. 7-26

PART 800 BRIDGE STRUCTURES

Section 801 General ……. 8-1
Section 802 Temporary Bridges ……. 8-2
Section 803 Removal of Existing Bridges ……. 8-3
Section 804 Driven Piles …….. 8-4

PART 800 BRIDGE STRUCTURES (Continued) **Page**

Section 805	Earth Retaining Systems	8-27
Section 806	Timber Construction	8-37
Section 807	Masonry Construction	8-43
Section 808	Cast-in-Place Structure Concrete Masonry	8-55
Section 809	Precast/Prestressed Structure Concrete Masonry	8-69
Section 810	Reinforcing Steel	8-79
Section 811	Weep Holes, Pavement Subdrains and Wall Drains	8-85
Section 812	Water Stops and Flashings	8-86
Section 813	Waterproofing and Dampproofing	8-88
Section 814	Placement of Concrete Bridge Decks	8-94
Section 815	Latex Modified Concrete for Bridge Overlays	8-102
Section 816	Earth Retaining Systems	8-106
Section 817	Timber Construction	8-110
Section 818	Masonry Construction	8-116
Section 819	Cast-in-Place Structure Concrete Masonry	8-119
Section 820	Precast/Prestressed Structure Concrete Masonry	8-120
Section 821	Sawing and Sealing Joints in Bituminous Concrete Pavements	8-122
Section 822	Silicone Highway Joint Seal	8-124
Section 823	Roadway Joints – Expansion and Fixed	8-125
Section 824	Structural Steel Construction	8-131
Section 825	Painting Structural Steel	8-152
Section 826	Personnel and Environmental Protection	8-161
Section 827	Thermal Sprayed Zinc Coating for New Structural Steel	8-164
Section 828	Bridge Bearings	8-167
Section 829	Bridge Scupper Piping	8-172
Section 830	Metal Bridge Railing	8-173
Section 831	Pedestrian Chain Link Fence – Aluminum	8-175
Section 832	Bridge Signs	8-177
Section 833	Granite Identification Tablets	8-179
Section 834	Granite Curb for Bridges	8-181
Section 835	Scuppers	8-182
Section 836	Structural Concrete Repair by Epoxy-Resin Base Adhesive Injection	8-182
Section 837	Repairs to Structural Concrete Masonry with Integrally Colored Concrete Patching Mortar	8-184
Section 838	Saw Cut in Existing Concrete Walls	8-189
Section 839	Remove and Dispose Bituminous Concrete Pavement From Concrete Bridge Decks – Partial Depth and Full Depth	8-189
Section 840	Deck Surface Concrete Removal by Hydrodemolition	8-191

PART 900 INCIDENTAL CONSTRUCTION AND SERVICES

Section 901	Steel Beam Guardrail	9-1
Section 902	Steel Backed Timber Guardrail	9-3
Section 903	Fences	9-5

PART 900 INCIDENTAL CONSTRUCTION AND SERVICES (Continued) **Page**

Section 904	Remove and Reset Fence	9-7
Section 905	Sidewalks and Driveways	9-9
Section 906	Curbing for Roadways	9-12
Section 907	Dust Control	9-18
Section 908	Flagstones	9-19
Section 909	Precast Concrete Median Barrier	9-20
Section 910	Raised Reflective Pavement Marker (Snow Plowable)	9-23
Section 911	Stone Masonry Walls	9-26
Section 912	Remove and Rebuild or Construct New Dry-Laid Stone Walls	9-28
Section 913	Trafficpersons	9-30
Section 914	Flagpersons	9-31
Section 915	Highway Bounds	9-32
Section 916	Remove, Relocate and Reset Shock Absorbing Barrier Modules	9-33
Section 917	Remove and Replace Rural Mail Box Post and Mountings	9-34
Section 918	Rural Mail Boxes Postmaster Approved	9-35
Section 919	Test Pits	9-36
Section 920	Riprap	9-37
Section 921	Slope Paving	9-39
Section 922	Temporary Construction Signs	9-40
Section 923	Portable Channelizing Devices and Barricades	9-42
Section 924	Advance Warning Arrow Panel	9-44
Section 925	Portable Changeable Message Sign	9-45
Section 926	Precast Concrete Median Barrier for Temporary Traffic Control	9-47
Section 927	Remove and Relocate Precast Concrete Median Barrier for Temporary Traffic Control	9-49
Section 928	Truck Mounted Attenuator (TMA) with Truck Mounted Flashing Arrow Board (TMFAB)	9-50
Section 929	Field Offices and Materials Laboratory	9-52
Section 930	Plant Field Laboratory	9-58
Section 931	Cleaning and Sweeping Pavement	9-63
Section 932	Cutting and Matching Pavement	9-65
Section 933	Sawcutting of Pavements for Installation of Traffic Count Loop Detectors	9-66
Section 934	Field Control and Construction Layout	9-66
Section 935	Removing Bituminous Pavement by Cold Planing	9-69
Section 936	Mobilization	9-70
Section 937	Maintenance and Movement of Traffic Protective Devices	9-71
Section 938	Price Adjustments	9-73
Section 939	Stone Walls in Historic, Scenic or Rural Areas	9-74
Section 940	On-Site Administration Facility	9-76
Section 941	Replacement of Partially Damaged Safety Related Hardware	9-78
Section 942	Detectable Warning Systems	9-78

PART T TRAFFIC CONTROL SYSTEMS **Page**

Section T.01 Electrical Work T-1
Section T.02 Highway Lighting T-5
Section T.03 Ground Rods & Bare Ground Wire T-6
Section T.04 Wire and Cable T-7
Section T.05 Handholes and Pull Boxes T-9
Section T.06 Conduit T-11
Section T.07 Luminaires T-13
Section T.08 Aluminum Lighting Standards and Foundations T-14
Section T.09 Service Pedestal T-17
Section T.10 Traffic Signal Systems T-18
Section T.11 Traffic Signal Standards and Posts T-21
Section T.12 Traffic Signal Controllers and Cabinets T-23
Section T.13 Detectors and Relays T-24
Section T.14 Traffic Signal Heads T-27
Section T.15 Directional, Regulatory and Warning Signs T-29
Section T.16 Ground Mounted Primary Directional Signs T-33
Section T.17 Overhead Sign Panels and Supports T-36
Section T.18 Delineators and Hazard Markers T-37
Section T.19 Milepost Markers T-39
Section T.20 Pavement Markings T-39
Section T.21 Temporary Construction Zone Reflective Pavement Delineators T-48
Section T.22 Lighting for Night Work Operations T-49

PART L LANDSCAPING

Section L.01 Loam, Plantable Soil or High Organic Soil L-1
Section L.02 Seeding L-4
Section L.03 Sodding L-8
Section L.04 Refertilization of Seeded, Sodded and Grassed Areas L-11
Section L.05 Seed Stabilizers L-12
Section L.06 Planting L-15
Section L.07 Extended Establishment Period L-22
Section L.08 Tree and Shrub Trimming L-26
Section L.09 Selective Clearing L-27
Section L.10 Tree and Shrub Root Pruning L-28
Section L.11 Tree and Shrub Protection Device L-29
Section L.12 Tree Cut-Out Paving L-31
Section L.13 Tree Wells and Tree Walls L-33
Section L.14 Herbicide L-34

DIVISION III

PART M MATERIALS **Page**

Section M.01	Borrow and Aggregates	M-1
Section M.02	Portland Cement Concrete	M-6
Section M.03	Bituminous Pavements	M-13
Section M.04	Drainage	M-18
Section M.05	Metals	M-23
Section M.06	Paint	M-31
Section M.07	Sheet Piling and Piles	M-33
Section M.08	Fence and Guardrail	M-35
Section M.09	Curbing	M-38
Section M.10	Dust Control, Riprap, Stone Walls, Cobblestones, Flagstones, Highway Bounds	M-42
Section M.11	Timber	M-44
Section M.12	Waterproofing, Dampproofing and Sealers	M-45
Section M.13	Bridge Bearings	M-49
Section M.14	Stone for Masonry	M-50
Section M.15	Traffic Control Systems	M-52
Section M.16	Signs and Sign Supports	M-70
Section M.17	Pavement Markings	M-89
Section M.18	Landscaping Materials	M-97

DIVISION I

PART 100

GENERAL REQUIREMENTS AND COVENANTS

SECTION 101

DEFINITIONS AND TERMS

101 DEFINITIONS AND TERMS. As used in Sections 102 – 109, the abbreviations and definitions set forth in this Section shall have the following meanings:

101.01 ABBREVIATIONS. Wherever the following abbreviations are used in the Contract, they mean:

AAN	American Association of Nurserymen
AAR	Association of American Railroads
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
AGC	Associated General Contractors of America
AIA	American Institute of Architects
AISI	American Iron and Steel Institute
ANSI	American National Standards Institute
ARA	American Railway Association
AREA	American Railway Engineering Association
ARTBA	American Road and Transportation Builders Association
ASCE	American Society of Civil Engineers
ASLA	American Society of Landscape Architects
ASTM	American Society for Testing and Materials
AWPA	American Wood Preservers' Association
AWWA	American Water Works Association
AWS	American Welding Society
FHWA	Federal Highway Administration; U.S. Department of Transportation
FSS	Federal Specifications and Standards
IMSA	International Municipal Signal Association
MIL	Military Specifications
MUTCD	Manual on Uniform Traffic Control Devices (For Streets & Highways)
NEC	National Electrical Contractors
NEMA	National Electrical Manufacturers Association
OSHA	Occupational Safety and Health Administration
SAE	Society of Automotive Engineers
TMP	Transportation Management Plan
UL	Underwriters Laboratory

101.02 ACTUAL COST. The cost actually incurred by the Contractor or subcontractor in the performance of work. Actual costs will include labor, material, actual ownership cost of equipment or invoiced rental rates, verified payroll burdens, verified general and administrative overhead, and profit. While the Contractor is required to establish such costs with competent documentation (i.e., invoices, certified payrolls, financial statements) the Department may rely upon an audit of the Contractor's financial records by a Department appointed auditor.

101.03 AWARD. The written acceptance by the State of the successful Proposal consisting of the executed Contract Agreement and Purchase Order.

101.04 BIDDER. An individual, partnership, corporation or joint venture submitting a Proposal for the advertised work. (The terms “Bidder” and “Contractor” are frequently used synonymously.)

101.05 BID DOCUMENTATION. The term "bid documentation" means all writings, working papers, computer printouts, charts, computer data files associated with the preparation and/or submittal of a bid proposal, and all other data compilation which contains or reflects information, data or calculations used by the Contractor to determine its bid submitted for a project. The term "bid documentation" includes material relating to the determination and application of equipment rates, overhead rates, labor rates, efficiency or productivity factors, arithmetic extensions, schedules for time or any determination of time related to project overhead, as well as quotations from subcontractors and material suppliers to the extent that such rates and quotations were used by the Contractor in formulating and determining the amount of the bid. The term "bid documentation" also includes any manuals which are standard to the industry used by the Contractor in determining the bid for a project. These manuals may be included in the bid documentation by reference, and will show the name and date of the Publication and the Publisher.

101.06 BRIDGE. A structure, including supports, erected over a depression or an obstruction, such as water, highway or railway, and having a track or passageway for carrying traffic or other moving loads and having a length measured along the center of roadway of more than twenty (20) feet between undercopings of abutments or extreme ends of openings for multiple boxes.

a. Bridge Length. The length of a bridge structure is the over-all length measured along the line of survey stationing back to back of backwalls of abutments, if present, otherwise end to end of the bridge floor; but in no case less than the total clear opening of the structure.

b. Bridge Roadway Width. The clear width measured at right angles to the longitudinal centerline of the bridge between the bottom of curbs or in the case of multiple height of curbs, between the bottom of the lower risers or in the case of no curbs, between the inner faces of parapet of railing.

101.07 CALENDAR DAY. Each and every day shown on the calendar, beginning and ending at midnight.

101.08 COMPENSABLE DELAY. An excusable delay for which the Contractor may be entitled to additional monetary compensation which is not otherwise precluded by these Regulations.

101.09 COMPLETION. Completion of the project occurs when; 1) The work has been satisfactorily completed in all respects in full accordance with the Contract, and; 2) the Contractor has satisfactorily executed and delivered to the Engineer all documents, certificates, and proofs of compliance as required by the Contract.

101.10 CONSTRUCTION AND MAINTENANCE AGREEMENT/UTILITIES. An agreement between the State, acting through its Department of Transportation, and the Owners of Utilities. Owners may be either Municipalities or private Utility Companies. The agreements establish conditions for removing, relocating, or otherwise altering the location of utilities to facilitate proposed highway construction work. They divide responsibility for such alterations between the two parties and establish payment procedures by which the State will reimburse the Owners for costs they incur in performing their respective portions of the work.

101.11 CONTRACT. The agreement between the State and the Contractor for the performance of the prescribed work and consisting of the following:

a. Contract Agreement. The written statement, executed by the State through the State Purchasing Agent or its designee and the Contractor; and approved by the Director, Department of Transportation, setting forth the obligations of the parties for the performance of the work.

b. Contract Documents. The Notice to Contractor (advertisement for bids); Proposal; Contract Bond(s); Standard Specifications; Supplemental Specifications; Special Provisions; General and Detailed Plans; Notice of Award; Notice to Proceed; and any subsequently executed Contract Addenda that are required to complete the construction of the work in an acceptable manner, including authorized Contract Time Extensions.

c. One Instrument. The executed Contract Agreement and the Contract Documents constitute one instrument; i.e., the Contract.

101.12 CONTRACT ADDENDUM. Any change to the Contract made after its initial execution, which change shall become part of the Contract Agreement. Contract Addenda must be set forth in writing and executed by the original signatories, or their successors in interest, or their designees. Each Contract Addendum must be preceded and documented by a corresponding Report of Change.

101.13 CONTRACT BONDS. The approved form of securities, executed by the Contractor and its Surety or Sureties, guaranteeing complete execution of the Contract and all supplemental agreements pertaining thereto, and the payment of all legal debts pertaining to the construction of the project.

101.14 CONTRACT ITEM (PAY ITEM). A specific item of work for which a price is provided in the Bid Schedule.

101.15 CONTRACT TIME. The number of work days or calendar days allowed for completion of the Contract including authorized time extensions. When a calendar date of completion is specified in the Proposal, the Contract shall be substantially completed on or before that date.

101.16 CONTRACTOR. The individual, partnership, corporation, or any combination thereof, or joint venture contracting with the State for performance of the prescribed work. (The terms “Contractor” and “Bidder” are frequently used synonymously.)

101.17 COUNTY. The county in which the work specified is to be performed.

101.18 CULVERT. Any structure which provides an opening under the roadway but which does not meet the classification of a "bridge" as defined in **Subsection 101.06**.

101.19 DAILY CHARGE. The per diem rate for liquidated damages specified in the Contract and so-established in accordance with the "Schedule of Liquidated Damages.”

101.20 DEPARTMENT. The Department of Transportation, as constituted under the laws of this State.

101.21 DIG SAFE. A one-call damage prevention system, established and funded by public utilities that own and operate underground facilities within the State, for the purpose of receiving and giving notice of proposed excavation activity pursuant to Chapter 39-1.2 of the General Laws of Rhode Island entitled, EXCAVATION NEAR UNDERGROUND UTILITY FACILITIES.

101.22 DIVISION OF PURCHASES. A division in the Department of Administration of the State of Rhode Island, the head of which is the State Purchasing Agent.

101.23 ENGINEER. The Chief Engineer of RIDOT, acting directly or through his or her duly authorized representatives, who is responsible for engineering and administrative supervision of the Contract.

101.24 EQUIPMENT. All machinery, tools, and apparatus, together with the necessary supplies for upkeep and maintenance, necessary for the construction and completion of the Contract.

101.25 EQUITABLE ADJUSTMENT. An adjustment in the Contract price and/or time occasioned by the performance of work beyond that required by the original Contract, including extra work, changes, certain differing site conditions and changes in quantities. The equitable adjustment of Contract price will be based on an agreed upon lump sum, agreed upon unit prices, force account, or the actual cost of the work. The equitable adjustment of the Contract time will be based on a comparison of the time demonstrated by the Contractor's schedule and the time required for the execution of the work.

101.26 EXCUSABLE DELAY. A delay to the Contract or Milestone/phase completion date, not otherwise precluded by these Regulations, which was unforeseeable and beyond the Contractor's control and not caused by the Contractor's fault or negligence and for which a Contract or Milestone time extension may be granted by the Department.

101.27 EXTRA WORK. Work not provided for in the Contract as awarded but considered essential to the satisfactory completion of the Contract.

101.28 FINANCIAL STATEMENTS. A set of reports, detailing on an annual, semi-annual or other prescribed time period, the financial activity or a company, corporation or other business venture. For purposes of Post Qualification and Award, these shall include a complete set of audited financial statements certified by a Certified Public Accountant (CPA) or, in the case of contracts valued at $500,000 or less, a bidder’s financial references and an original copy of its current financial statement.

101.29 FORCE ACCOUNT. A method of payment for extra work ordered by the Engineer when no other method of payment is provided for in the Contract and when the Contractor and the Engineer are unable to agree upon an acceptable method. The force account method of payment provides for reimbursing the Contractor for those actual costs it incurred in performing such work.

101.30 GEOTEXTILE. Any permeable textile material used with foundation, soil, rock, earth, drainage, or any other geotechnical engineering related material, as an integral part of a man-made project, structure, or system.

101.31 HIGHWAY, STREET, OR ROAD. A general term denoting a public way for purposes of vehicular and pedestrian travel, including the entire area within the Right-of-Way.

101.32 HOLIDAYS. In the State of Rhode Island legal holidays occur on New Year's Day; Martin Luther King Day; Memorial Day; Independence Day; Victory Day; Labor Day; Columbus Day; Veteran's Day; Thanksgiving Day; and Christmas. If any holiday listed above falls on a Sunday, the following Monday shall be considered a holiday.

101.33 INCLEMENT WEATHER. Any day or days for which the Engineer decides that weather conditions are so extreme and/or severe that normal construction operations should not proceed

101.34 LABORATORY. The testing laboratory of the Department or any other testing laboratory which may be designated by the Engineer.

101.35 LIQUIDATED DAMAGES. Deductions from monies due the Contractor, assessed on a daily basis, to compensate the State for losses incurred because of the failure of the Contractor to complete the work within the time established by the Contract.

101.36 MAJOR AND MINOR CONTRACT ITEMS. Any item having an original value in excess of 5 percent of the original Contract amount shall be considered to be a major item. All other original Contract items shall be considered minor items. In addition, any minor item which increases by 100 percent will be considered a major item. The revised quantity will then be considered the original Contract quantity for purposes of determining a major item of work under **Subsection 104.07; Significant Changes in the Character of Work**.

101.37 MATERIALS. Any substances specified for use in the construction of the project.

101.38 NONCOMPENSABLE DELAY. An excusable delay for which the Contractor may be entitled to an extension of time but no additional monetary compensation.

101.39 NON-EXCUSABLE DELAY. A delay to the Contract or Milestone/phase completion date which was reasonably foreseeable and within the control of the Contractor for which no time extension will be granted.

101.40 NOTICE TO CONTRACTORS. A public announcement inviting bids for work to be performed and/or materials to be furnished. Such notice will indicate with reasonable accuracy the nature and location of the work to be performed; the time and place of the opening of Proposals; and any Contract statutory provisions required by the Federal Government.

101.41 NOTICE TO PROCEED. Written notice from the Engineer to the Contractor to commence the Contract work and which designates the date of beginning of Contract time.

101.42 NOTICE OF TENTATIVE AWARD. A written communication from the State or its designee to the successful bidder indicating the conditional intention of the State to award the Contract. This communication instructs the successful bidder to arrange a meeting with the appropriate State official within fifteen days of the receipt of said notice for the purpose of executing the Contract Agreement and Contract Bonds, and for the delivery of the required Certificates of Insurance.

101.43 PAVEMENT STRUCTURE. The combination of subbase, base course and surface course placed on a subgrade to support the traffic load and distribute it to the roadbed.

a. Subgrade. The top surface of a roadbed upon which the pavement structure, should-ers, and curbs are constructed.

b. Subgrade Treatment. Modification of roadbed material by stabilization.

c. Subbase. The layers of specified or selected material of designed thickness placed on a subgrade to support a base course.

d. Base Course. The one or more layers of specified material and thickness placed on a subbase or a subgrade to support a surface course.

e. Surface Course. One or more layers of a pavement structure designed to accommodate the traffic load, the top layer of which resists skidding, traffic abrasion, and the disintegrating effects of climate. The top layer is sometimes called the "wearing surface."

101.44 PLANS. The approved plans, profiles, typical cross sections, working drawings and supplemental drawings, or exact reproductions thereof, which show the location, character, dimensions, and details of the work to be performed.

101.45 PRECONSTRUCTION CONFERENCE. A meeting between the Contractor and the Engineer prior to the actual commencement of work for the purpose of reviewing the following:

a. The Contractor's submission of construction schedules.

b. The Contractor's involvement with public and private utilities.

c. The Contractor's proposed methods and procedures for prosecuting the work.

d. Any questions the Contractor may wish to ask relative to the prosecution of the work.

101.46 PROFILE GRADE. The trace of a vertical plane intersecting the top surface of the proposed wearing surface, usually along the longitudinal centerline of the roadbed. Profile grade means either elevation or gradient of such trace according to the context provided.

101.47 PROJECT. The specific section of the highway or other specific property on which construction is to be performed as described in the Contract.

101.48 PROPOSAL. The written offer of a bidder, on prescribed forms generated by the Department of Transportation’s approved proposal preparation computer software, to perform the stated work at the prices quoted. As used herein, "Proposal" is synonymous with "bid.”

101.49 PROPOSAL FORM. The prescribed form, generated by the Quest Lite bid preparation software, on which the offer of a bidder is submitted.

101.50 PROPOSAL GUARANTY. The security furnished with a Proposal to assure that the bidder will enter into the Contract if the Proposal is accepted.

101.51 PURCHASE ORDER. A document issued by the State Purchasing Agent, and transmitted to the Contractor with copies of the executed Contract, that indicates that appropriate accounts have been established and that funds have been assigned to those accounts for the purpose of reimbursing the Contractor for its work in implementing the Contract.

101.52 QUEST LITE. The computer software used by bidders to prepare a bid proposal.

101.53 RESIDENT ENGINEER. The Engineer's authorized representative at the site of the work whose main responsibility is to insure Contract compliance.

101.54 RESPONSIVE BID. A Proposal which complies with all material requirements of the Notice to Contractors.

101.55 REPORT OF CHANGE. A written order to the Contractor covering contingencies, extra work, increases or decreases in Contract quantities, and additions or alterations to the Plans or Specifications, within the scope of the Contract, and establishing the basis of payment and time adjustments for the work affected by said changes. A Report of Change provides the required documentation for the execution of a Contract Addendum.

101.56 RIGHT-OF-WAY. A general term denoting land, property, or interest therein, usually in a strip, acquired for or devoted to transportation purposes.

101.57 ROADBED. The graded portion of a highway within top and side slopes, prepared as a foundation for the pavement structure and shoulders.

101.58 ROADSIDE. A general term denoting the area adjoining the outer edge of the roadway. Extensive areas between the roadways of a divided highway may also be considered roadside.

101.59 ROADSIDE DEVELOPMENT. Those items necessary for the preservation of landscape materials and features; the rehabilitation and protection against erosion of all areas disturbed by construction through seeding, sodding, mulching and the placing of other ground covers; such suitable planting and other improvements as may increase the effectiveness and enhance the appearance of the highway.

101.60 ROADWAY. The portion of a highway within limits of construction.

101.61 SHOULDER. The portion of the pavement structure contiguous with the traveled way for accommodation of stopped vehicles, for emergency use, and for lateral support of base and surface courses.

101.62 SIDEWALK. That portion of the roadway primarily constructed for the use of pedestrians.

101.63 SPECIALTY ITEMS. Those specific work items listed in either the Bid Schedule or elsewhere in the Contract whose Item Numbers are designated by the prefix "S." The work required to implement specialty items is considered to be a type that a Contractor would not generally perform with its own organization.

101.64 SPECIFICATIONS. The compilation of provisions and requirements for the performance of the prescribed work and consisting of the following:

a. Standard Specifications; a book of specifications approved for general application and repetitive use. Specifically, the Rhode Island Standard Specifications for Road and Bridge Construction of latest revision.

b. Supplemental Specifications; approved additions and revisions to the Standard Specifications.

c. Special Provisions; additions and revisions to the Standard and Supplemental Specifications applicable for an individual project.

d. The Required Contract Provisions for Federal-Aid Projects, when applicable.

e. Federal Wage Rates; a schedule of prevailing rates of wages of labor for the geographical area in which the work of the Contract is to be performed; compiled by, and issued from time to time by the Secretary of the United States Department of Labor.

101.65 SPECIFICATION BOOKLET. **[DEFINITION DELETED]**

101.66 SPECIFIED COMPLETION DATE. The date stated in the Proposal on which the Contract work, or specified portion thereof, is to be substantially completed.

101.67 STABILIZATION. Modification of soils or aggregates by incorporating materials that will increase load-bearing capacity, firmness, and resistance to weathering or displacement.

101.68 STATE. The State of Rhode Island and Providence Plantations acting through its authorized representatives.

101.69 STRUCTURES. Bridges, culverts, catch basins, drop inlets, retaining walls, cribbing, manholes, endwalls, buildings, sewers, service pipes, underdrains, foundation drains and other features which may be encountered in the work.

101.70 SUBCONTRACTOR. An individual or legal entity with whom the Contractor sublets part of the work.

101.71 SUBSTANTIAL COMPLETION. Substantial completion of a unit, or portion of the work such as a structure, an interchange, or section of road or pavement occurs at the point at which the portion of the work is complete such that it can be safely and effectively used by the public and when the following criteria are realized: **1)** All courses of pavement are complete; **2)** curbing and sidewalks are placed; **3)** all project drainage is complete; **4)** guardrail and terminal sections are properly installed; **5)** pavement markings are in place; **6)** traffic signal systems meet the following requirements: (a) isolated traffic signals - the signal control equipment is fully programmed, detectors are installed and functioning, and the signal is in actuated operation, (b) coordinated traffic signal systems - the requirements of condition (a) are met, the interconnect is installed and functioning, and the signals are operating as a coordinated system, (c) closed loop signal systems - the conditions of (a) and (b) are met, the communications link is operating, and the monitoring functions, including system and intersection graphics, are installed and operating at the Department's monitoring stations; **7)** regulatory and warning signs are installed; **8)**

highway lighting is operational; and **9)** only corrective or repair work remains for the physical completion of the Contract.

101.72 SUBSTRUCTURE. All of the structure below the bearings of simple and continuous spans, skewbacks of arches, and tops of footings of rigid frames, and including backwalls, wingwalls and wing protection railings.

101.73 SUPERINTENDENT. The Contractor's authorized representative in responsible charge of the work.

101.74 SUPERSTRUCTURE. The entire structure except the substructure as defined in **Subsection 101.72**.

101.75 SUPPLEMENTAL AGREEMENT. A Contract Addendum signed by the Department and the Contractor for the performance of work which is beyond the scope of the original Contract but which the Department elects to perform in conjunction with the existing Contract.

101.76 SURETY. The legal entity, or individual other than the Contractor, executing a bond or bonds furnished by the Contractor.

101.77 TITLES (OR HEADINGS). The titles or headings of the sections and subsections herein are intended for convenience of reference and shall not be considered as having any bearing on their interpretation.

101.78 TOWNSHIP, TOWN, CITY OR DISTRICT. A subdivision of the State used to designate or identify the location of the proposed work.

101.79 TRAVELED WAY. The portion of the roadway provided for the movement of vehicles, exclusive of shoulders and auxiliary lanes.

101.80 WINTER SHUTDOWN. The period from December 15th through the following April 15th.

101.81 WORK. The furnishing of all labor, materials, equipment, and other incidentals necessary for the successful completion of the project in accordance with the Contract

101.82 WORKING DAY. A calendar day during which normal construction operations could proceed for a major part of a shift, normally excluding Saturdays, Sundays and holidays.

101.83 REPETITION OF EXPRESSIONS. In order to avoid cumbersome and confusing repetition of expressions in these Specifications, it is provided that whenever anything is, or is to be, done, if, as, or, when, or where "contemplated, required, determined, directed, specified, authorized, ordered, given, designated, indicated, considered, necessary, deemed necessary, permitted, reserved, suspended, established, approval, approved, disapproved, acceptable, unacceptable, suitable, accepted, satisfactory, unsatisfactory, sufficient, insufficient, rejected or condemned," it shall be understood as if the expression were followed by the words "by the Engineer" or "to the Engineer."

101.84 CONTRACT AWARD BOOKLET. A document provided to the Contractor after the award of the Contract containing the following elements of the Contract Documents: Notice to Contractors; the Bidder’s Proposal; executed copies of both the Contract Agreement and Contract Bonds; and a Contract Award compact disk (CD) containing the RI Standard Specifications for Road and Bridge Construction, Supplemental Specifications, Special Provisions, Required Contract Provisions for Federal-Aid Projects,

Federal Wage Rates, all Contract Addenda issued prior to the date of the opening of proposals, Distribution of Quantities, Plans, Appendices and Bid Analysis Reports.

101.85 CONTRACT BID PACKAGE. A compact disk (CD) containing the following items, provided to prospective bidders for bid preparation purposes: RI Standard Specifications for Road and Bridge Construction, Supplemental Specifications, Special Provisions, Required Contract Provisions for Federal-Aid Projects, Federal Wage Rates, Distribution of Quantities, Plans, Appendices, the Quest Lite installation software and the Quest Lite bid file.

101.86 TRANSPORTATION MANAGEMENT PLAN. The document that lays out the set of coordinated transportation management strategies that will be used to manage the work zone safety and mobility impacts of the project.

101.87 TMP IMPLEMENTATION MANAGERS. The project managers with the primary responsibility and authority for implementation of the Transportation Management Plan. The Department and the Contractor must each designate on the Transportation Management Plan their respective TMP Implementation Manager for the project.

SECTION 102

BIDDING REQUIREMENTS AND CONDITIONS

102.01 PREQUALIFICATION OF BIDDERS. Prequalification of bidders shall be in accordance with 23 CFR 635, Rhode Island General Law 37-2, together with regulations and procedures promulgated thereunder, and those Regulations.

102.02 CONTENTS OF PROPOSAL FORMS. The completed Proposal Form is generated by the Department's Quest Lite bid preparation software, which is furnished to the prospective bidder on compact disk (CD) as part of the Contract Bid Package with the Plans, Specifications and additional contract bid documents in accordance with the instructions set forth in the Notice to Contractors.

The Proposal Form consists of three parts. The first part, the "Preamble," outlines the various understandings and agreements required of the prospective bidder as conditions to its offer to perform the stated work. The second part, the "Bid Schedule," is that portion of the form where the various items of work are listed in a numbered sequence, and includes the unit prices entered by the bidder and total bid amounts of each item, which are computed by Quest Lite. The third part of the form is the "Signature Page," which includes the "Total, or Gross Sum of Bid" and which must be signed by the bidder or his authorized signatory. This signature signifies the bidder's acceptance of all requirements and conditions of the Contract and its agreement to substantially complete the work by a calendar date certain.

The Plans, Specifications and other contract bid documents designated in the Proposal Form will be considered a part of the Proposal.

When applicable, prospective bidders will be required to pay the Department the sum stated in the Notice to Contractors for each set of Contract Bid Packages taken out by said bidders.

In the case of joint ventures, Contract Bid Packages must be taken by the Joint Venture; this does not, however, preclude entities comprising the Joint Venture from taking out Contract Bid Packages independently. In addition, the Joint Venture must be independently registered as a user of the Department's Electronic Bidding System known as Quest Lite.

102.03 INTERPRETATION OF QUANTITIES IN BID SCHEDULE. The quantities appearing in the Bid Schedule are estimated and are used for the comparison of Proposals. Payment to the Contractor will be made for the actual quantities of work performed and accepted or materials furnished in accordance with the Contract. The estimated quantities of work to be performed and the materials to be furnished may be increased, decreased, or omitted as deemed necessary or advisable by the Engineer, or as hereinafter provided.

102.04 EXAMINATION OF PLANS, SPECIFICATIONS, SPECIAL PROVISIONS, AND SITE OF WORK. The bidder is expected to carefully examine the site of the proposed work, the Proposal, the Plans, the Rhode Island Standard Specifications for Road and Bridge Construction, Supplemental Specifications, Special Provisions, Distribution of Quantities and Contract Forms before submitting a Proposal. The submission of a Proposal will be considered conclusive evidence that the bidder has made such an examination and is satisfied as to the conditions to be encountered in performing the work and as to the requirements of the Contract as defined in the Contract Documents.

Boring logs and other records of subsurface investigations are available for inspection by bidders. It is understood that such information was obtained and used for Department design and estimating purposes only. It is made available to bidders so all have access to identical subsurface information available to the Department. Furthermore, this information is not intended as a substitute for personal investigation, interpretations, and judgment of the bidders.

The locations of all utilities as shown on the Plans are approximate. The Contractor shall seek to determine the exact location of all existing utilities, both underground and overhead, by notifying Dig Safe in accordance with State law. Damage to utilities which are shown on the Plans or located by the respective utilities in accordance with the Dig Safe process shall be the responsibility of the Contractor. Damage to utilities and their associated service connections which are not shown on the Plans or located by the respective utilities in accordance with the Dig Safe process, will be paid for by the Department.

102.05 PREPARATION OF PROPOSAL. The bidder's attention is directed to the fact that all Proposals must be generated by RIDOT'S Quest Lite software, and the Proposal must be submitted to the Purchasing Division of the Department of Administration in the form of an electronic file on a compact disk (CD), which should be labeled and identified, at a minimum, with the bidder's name and the Rhode Island construction contract number of the project being bid. In addition, the bidder shall submit its Proposal in hard copy format on forms generated by the Department of Transportation's Quest Lite program.

The bidder shall specify a unit price in words and figures, for each pay item for which a quantity is provided. All pay items for which a bidder is required to specify a unit price shall have a bid price of at least one cent. The Quest Lite software requires a unit price to be entered for each pay item and will not allow a unit price of less than one cent to be entered as a bid price for an individual pay item. The bidder shall show the products of the respective unit prices and quantities written in figures in the column provided for that purpose and the total amount of the Proposal obtained by adding the amounts of all items. The total bid price is to be based on the unit prices written in words, correctly extended and added. In case of a discrepancy between the unit prices written in words and those written in figures, the unit prices written in words shall govern. The State reserves other rights as noted in **Subsection 103.01; Consideration of Proposals**.

When the Proposal contains a choice to be made by the bidder, the bidder shall indicate its choice in accordance with the instructions for that particular item. Thereafter, no further choice will be permitted.

Erasures and alterations to the Proposal shall not be permitted.

A copy of the Joint Venture agreement must be included with the Proposal when submitted. The Joint Venture agreement must clearly identify the entities which comprise the Joint Venture and the Officers of the Joint Venture.

The bidder's hard copy Proposal generated from the Quest Lite software must be signed in ink by an authorized signatory of the partnership, joint venture, corporation, or by such other agent of the Contractor legally qualified and acceptable to the State as hereinafter provided.

If the Proposal is made by an individual, his/her name and mailing address shall be shown; by a partnership, the name and mailing address of each partnership member shall be shown; as a joint venture, the name and mailing address of each member or officer of the firms represented by the joint venture shall be shown; by a corporation, the name of the corporation and the business address of its corporate office shall be shown. In the case of Partnership and/or Joint Venture, the names and addresses of each member or officer of the partnership or joint venture must be listed in a separate attachment to be included with the submitted proposal.

All certification documents are contained within the bid file that is used by the Quest Lite program. By utilizing Quest Lite, bidders are agreeing that they have executed all required certifications enumerated in the Proposal Report labeled “DOCUMENT(S)” which is located at the end of the Proposal Form. Failure to comply with the requirements of the Quest Lite software will not enable the bidder to successfully complete the preparation of a bid proposal.

102.06 PROPOSAL GUARANTY. A Proposal will not be accepted or considered unless accompanied by a guaranty in the form of an original Bid Bond made payable to the State of Rhode Island. Bid bonds must be provided by surety companies licensed and authorized to conduct business in the State of Rhode Island. All surety companies must be listed with the Department of the Treasury, Fiscal Services, Circular 570, (Latest Revision published by the Federal Register). The amount of the Proposal Guaranty shall be as designated in the Notice to Contractors.

When the bidder is a joint venture, the Proposal Guaranty must be made out to the name of the Joint Venture and all parties of the Joint Venture must be named in the execution of the Proposal Guaranty made by the same thereon. If there is more than one surety to the Bid Bond, each surety shall be named and execution made by same thereon.

Execution of the Bid Bonds will not be considered complete unless accompanied by a certified copy of the power of attorney for the surety's attorney-in-fact.

102.07 IRREGULAR PROPOSALS.

a. Mandatory Reasons for Disqualification in Addition to Others as Set Forth in Those Regulations. The Department will declare a proposal non-responsive and shall disqualify a bidder for any of the following irregularities:

1. If the Proposal Form is obtained from any party other than the Department. (Proposal Forms are non-transferable.)

2. If the Proposal is on a form other than that generated by the Department of Transportation's Quest Lite software; or if the form is altered or any part thereof is detached or incomplete;

3. If there are unauthorized additions, unauthorized conditional or alternate bids, or irregularities of any kind which may tend to make the Proposal incomplete, indefinite, or ambiguous as to its meaning;

4. If the bidder adds any provisions reserving the right to accept or reject an award;

5. If the Proposal is not completed using the Quest Lite software;

6. If the Department determines that the low bid is both mathematically and materially unbalanced;

7. If the Proposal is received after the time designated for the opening of bids;

8. If the bidder fails to execute the required certifications enumerated in the Proposal Report labeled "DOCUMENT(S)" located at the end of the Proposal;

9. If the bidder fails to submit an original Bid Bond, properly executed.

10. If compact disk (CD) data files and the hard copy submission do not match, unless such a discrepancy is determined to be the result of an error or malfunction within the Department's Quest Lite software.

11. If a compact disk (CD) is not submitted; or

12. If the Proposal pages generated by the Quest Lite software have been altered in any way.

b. Other Reasons for Disqualification in Addition to Other Reasons Set Forth in Those Regulations. The Department and the Division of Purchases reserve the right to declare a proposal non-responsive and may disqualify a bidder for any of the following irregularities:

1. If the bidder fails to include at least a minimum amount where required for a particular item;

2. If the Proposal does not contain a "total or gross sum of bid," written in words and figures, in the space provided;

3. If the Proposal is not properly signed;

4. If the bidder fails to comply in every detail with the instructions provided in **Subsection 102.05; Preparation of Proposal**;

5. If the Proposal is not submitted in a sealed envelope and clearly labeled as to its contents;

6. If the compact disk (CD) containing the bidder's Proposal is unreadable by the Department of Transportation's bid proposal software.

102.08 DELIVERY OF PROPOSALS. Proposals shall be submitted in sealed envelopes. The envelope shall be labeled to clearly indicate its contents. When sent by mail, the sealed Proposal shall be addressed in care of the official in whose office the bids are to be received, all as indicated in the Notice to Contractors. Proposals shall be filed prior to the time and at the place specified in the Notice to Contractors.

102.09 WITHDRAWAL OR REVISION OF PROPOSALS. A bidder may withdraw or revise a Proposal after it has been deposited with the Division of Purchases, provided the request for such withdrawal or revision is received by the Division of Purchases, in writing or by telegram, not later than two (2) hours before the time set for opening proposals. Upon presentation of its written request at the proper time, a bidder's Proposal will be returned unopened. If a Proposal is withdrawn in accordance with this provision, the proposal guaranty shall be returned to the bidder.

Whether or not Proposals are opened exactly at the time set for such opening, a Proposal will not be received, nor may any be withdrawn, after the time set for the opening of proposals.

The Department reserves the right to revise the Plans, Specifications, other Contract Documents, the Proposal, and bid opening date for any project at any time prior to the time set for opening of Proposals. Such revisions will be made by addendum, duly numbered and dated, and made accessible to bidders through the RIDOA, Division of Purchases' website known as the R. I. Vendor Information Program (RIVIP) at http://www.purchasing.ri.gov.

102.10 COMBINATION OR CONDITIONAL PROPOSALS. If the Department so elects, Proposals may be issued for projects in combination or separately, so that Proposals may be submitted either on the combination or on separate units of the combination. The Department and Division of Purchases reserve the right to make awards on combination bids or separate bids to the advantage of the State. No combination of Proposals, other than those as specified by the Department, will be considered. Separate contracts will be written for each individual project included in the combination.

Conditional proposals will be considered only when specified in the Special Provisions.

102.11 PUBLIC OPENING OF PROPOSALS. Proposals will be opened and read publicly at the time and place indicated in the Notice to Contractors or as amended by duly authorized Contract Addenda. Bidders, their authorized agents, and other interested parties are invited to be present at the opening of Proposals.

102.12 DISQUALIFICATION OF BIDDERS AND REJECTION OF PROPOSALS.

a. Mandatory Reasons for Disqualification. The Department will declare a Proposal unresponsive and shall disqualify a bidder for any of the following reasons:

1. More than one Proposal for the same work from an individual, partnership, corporation or joint venture under the same or different name;

2. Evidence of collusion among bidders. Participants in such collusion will not be considered for future proposals until re-qualified by the Department;

3. The making of false statements on prequalification documents and/or other required bidder's certifications;

4. Failure to comply with any prequalification requirements as set forth in **Subsection 102.01**;

5. Debarment by Federal or State authorities; or

6. Failure to provide a properly executed Contract Bond.

b. Other Reasons for Disqualification. The Department and the Division of Purchases reserve the right to declare a Proposal unresponsive and may disqualify a bidder for any of the following reasons:

1. Lack of competency and adequate machinery, plant and other equipment;

2. Uncompleted work under Contract which, in the judgment of the Department, might hinder or prevent the prompt completion of additional work, if awarded;

3. Failure to pay, or satisfactorily settle, all bills due for the Prime Contractor's labor and material on Contracts in force with the Department at the time of the Bid Opening;

4. Failure to pay or satisfactorily settle Subcontractor Payments as provided for under **Section 109.12, Subcontractor Prompt Payment** where good cause, as determined by the Department of Transportation, has not been accepted. Determination of failure to pay or satisfactorily settle Subcontractor Payments will be made within 30 days of bid opening; provided however that the bidder shall have the right to either pay or settle any such claims within said 30-day period.

5. Failure to comply with any post qualification regulations or requirements of either the Department or the Division of Purchases;

6. Default under previous contracts;

7. Unsatisfactory performance on a previously awarded contract; or

8. Failure to reimburse the State for monies owed on any previously awarded contracts including those where the prospective bidder is a party to a joint venture and the joint venture has failed to reimburse the State for monies owed.

102.13 MATERIAL GUARANTY. The successful bidder may be required to furnish a complete statement of the origin, composition, and manufacture of any or all materials to be used in the construction of the work, together with samples to be tested for conformance with Contract provisions.

a. Domestic Steel Products. The bidder is advised of the "Buy American" requirements that apply to domestic steel products as set forth in **Subsection 106.01a** of these Specifications.

102.14 BIDDING CERTIFICATIONS.

a. Non-Collusive Bidding Certification.

1. The Certificates. Every Proposal submitted to the Department shall contain an Anti-Collusion Certificate for Contract and Force Account duly subscribed to and affirmed by the bidder as true under the penalties of law.

2. Certifications. By submission of a Proposal, each bidder and each person signing the Proposal, which includes the Anti-Collusion Certificate on behalf of the bidder, certifies as to its own organization, under penalty of perjury, that to the best of their knowledge and belief:

(a) The prices in this Proposal have been arrived at independently without collusion, consultation, communication, or agreement with any other bidder or with any competitor for the purpose of restricting competition.

(b) Unless required by law, the prices which have been quoted in this Proposal have not been knowingly disclosed and will not knowingly be disclosed by the bidder, directly or indirectly, to any other bidder or competitor prior to opening of Proposals.

(c) No attempt has been made or will be made by the bidder to induce any other person, partnership, or corporation to submit or not to submit a proposal for the purpose of restricting competition.

3. Non-Compliance. The Quest Lite software will not enable a prospective bidder to complete the preparation of a Proposal unless the bidder certifies that he is in compliance with **Paras. 2(a), 2(b), and 2(c)** above.

The fact that a bidder; (1) has published price lists, rates, or tariffs covering items being procured, (2) has informed prospective customers of proposed or pending publication of new or revised price lists for such items, or (3) has sold the same items to other customers at the same prices being bid, does not constitute a disclosure within the meaning of **2(a)**.

The Proposal submitted to the Department will be considered as authorized by the board of directors of the bidder. Such authorization will be deemed to include the signing and submission of the Proposal and the inclusion therein of the certificate as to non-collusion on the part of the corporation.

The signers of the Proposal hereby tender to the Department a statement that the named Contractor has not, either directly or indirectly, entered into any agreement, participated in any collusion, or otherwise taken any action to restrain free competitive bidding in connection with the Proposal.

b. Certification Regarding Debarment, Suspension and Other Responsibility Matters.

1. The Certificate. Every Proposal submitted to the Department shall contain a Certification Regarding Debarment, Suspension and Other Responsibility Matters, duly subscribed to and affirmed by the bidder as true under the penalties of law.

2. Certification. By submission of a Proposal, each bidder and each person signing the Proposal, which includes the Debarment Certification on behalf of the bidder, certifies as to its own organization, under penalty of perjury, that to the best of their knowledge and belief:

(a) Are not presently debarred, suspended, proposed for debarment, declared ineligible or voluntarily excluded from covered transactions by any Federal department or agency;

(b) Have not, within a three-year period preceding the submission of a Proposal been convicted of or had a civil judgment rendered for commission of fraud or a criminal offense in connection with obtaining or performing a pubic contract or transaction;

(c) Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity;

(d) Have not, within the prior three-year period, had one or more public transactions terminated for cause or default.

3. Non-Compliance. In the event a prospective bidder is unable to certify to one or more of the conditions above, the bidder must attach a list of exceptions to the hard copy proposal generated by the Quest Lite program. Exceptions listed will not necessarily result in denial of award, but will be considered in determining contractor responsibilities.

The Quest Lite software allows a prospective bidder to either certify that he is in compliance with the provisions outlined in **Paras. 2(a), (b), (c),** and **(d)**, above, or to not certify these provisions and instead provide with the Proposal a list of exceptions to document the reason(s) why he is unable to certify his compliance with these provisions. In the latter case, the software will generate a statement on the signature page of the Proposal that additional documentation is attached in support of the bidder's inability to fully certify to the provisions.

c. Disadvantaged Business Enterprise Affirmative Action Certificate.

1. The Certificate. For all contracts containing provisions for the participation of Disadvantaged Business Enterprises (DBEs), prospective bidders shall be required to complete a Certification affirming compliance with the U.S. Department of Transportation and applicable State of Rhode Island regulations regarding participation by Disadvantaged Business Enterprises in the contract as contractors, subcontractors and/or suppliers of materials and services.

2. Certification. By submission of a Proposal, each bidder and each person signing a Proposal which includes the DBE Certification certifies that the organization shall affirmatively seek out and consider Disadvantaged Business Enterprises to participate in the contract, and develop and submit for approval to the Department, within ten days from the receipt of bids, a Disadvantaged Business Enterprise Program in accordance with the provisions of the DBE Certification.

3. Non-Compliance. The Quest Lite software will not enable a prospective bidder to complete the preparation of a bid Proposal unless the bidder completes the DBE Certification form in the Proposal.

d. Disclosure of Lobbying Activities.

1. The Certificate. Every bidder shall be required to certify and disclose, through the bid preparation process, any lobbying of Federal agencies, employees, officers, Members of Congress, or officers or employees of Congress or Members of Congress in connection with a covered Federal action.

2. Certification. By submission of a Proposal, each bidder and each person signing a Proposal certifies that, to the best of their knowledge and belief:

(a) No Federal appropriated funds have or will be paid, by or on behalf of the prospective bidder, to any individual or entity for the purpose of influencing or attempting to influence any Federal agency, employee or officer thereof in connection with the awarding of any Federal contract, the making of a Federal grant or load, or any other form of a contractual nature.

(b) If any funds other than Federal appropriated funds have been paid for the purpose of influencing any Federal agency, employee or officer thereof, the prospective bidder shall complete and submit as part of the bid Proposal submission, Standard Form LLL "Disclosure Form to Report Lobbying" in accordance with its instructions.

The prospective bidder also acknowledges by submitting a bid Proposal that the requirements of this certification shall also apply to all lower tier subcontracts which exceed $100,000, and that all subcontractors shall certify and disclose accordingly.

3. Non-Compliance. The Quest Lite software will not enable a prospective bidder to complete the preparation of a bid Proposal unless the bidder certifies that he has met the requirements of **Paras. 2 (a)** and **(b)**, above. In order to complete a bid Proposal, the bidder is required to certify that no Federal appropriated funds have been used for lobbying purposes, to certify whether other sources of funds have been used for lobbying and if so, to report this activity on Standard Form LLL, which is included in the Quest Lite software.

SECTION 103

AWARD AND EXECUTION OF THE CONTRACT

103.01 CONSIDERATION OF PROPOSALS. After the Proposals are opened and read, they will be compared on the basis of the summation of the products of the estimated quantities shown in the Proposal by the unit bid prices. The results of such comparisons will be made available to the public.

The State reserves the right to correct arithmetic errors in the Proposals prior to comparison of said Proposals. In the event of a discrepancy between unit bid prices and extensions, the unit bid price shall govern.

The State reserves the right to reject any or all Proposals, to waive technicalities or to advertise for new Proposals.

103.02 POST-QUALIFICATION REQUIREMENTS AND AWARD OF CONTRACT.

a. Submission of Post Qualification Requirements. All post qualification requirements shall be submitted as specified in the Contract Documents. This includes, but is not limited to, all documentation and requirements referenced under Part II: ACTION REQUIRED BY CONTRACTOR, as contained in the Special Provision entitled, "Disadvantaged Business Enterprise Affirmative Action Certification for Contractors and Consultants." This Special Provision is located in the section of the Contract Documents entitled REQUIRED CONTRACT PROVISIONS FOR FEDERAL-AID PROJECTS.

As part of the post qualification submission, the Contractor must designate on the Transportation Management Plan the Contractor's TMP Implementation Manager for the Contract. The Contractor's TMP Implementation Manager, together with the Department's TMP Implementation Manager are the persons with the primary responsibility and authority for implementation of the Transportation Management Plan.

b. Financial Statements. The successful bidder will be required to submit a complete set of audited financial statements certified by a Certified Public Accountant (CPA). For contracts valued at $500,000 and under, the successful bidder is required to submit only its financial references and an original copy of its current financial statement.

c. Award of Contract. Contract award, if it be awarded, will be made within sixty (60) calendar days following the opening of Proposals, or within the time specified in the Notice to Contractors, to the lowest responsible and qualified bidder who submits the lowest responsive Proposal.

The successful bidder will first receive a Notice of Tentative Award. This written communication will indicate the conditional intention of the State to award the Contract and instruct the successful bidder to arrange for the execution of the Contract Agreement and Contract Bond and for the delivery of the Certificates of Insurance, all as hereinafter provided.

On Contracts jointly bid, Contractors will be held jointly and severally liable for the entire Contract.

Corporate bidders must furnish documentary evidence that they have met all legal requirements to transact business in the State of Rhode Island as a condition precedent to approval of the Contract.

103.03 CANCELLATION OF AWARD. Both the Department and Division of Purchases reserve the right to cancel the award of any Contract before the execution thereof by all parties without any liability against the State.

103.04 RETURN OF PROPOSAL GUARANTY. The State reserves the right to retain the surety of all bidders until either the successful bidder enters into the Contract or until such time as the award or cancellation of the Contract is announced. At this point sureties will be returned to all bidders.

A Contractor will not be released from the bidding obligation because of an alleged error in the preparation of the Proposal unless the State returns the Contractor's Proposal Guaranty.

103.05 CONTRACT BOND. At the time of the execution of the Contract, the successful bidder shall furnish a Contract Bond in a sum equal to the full amount of the Contract. The Contract Bond shall guarantee the following; complete performance of the Contract; full payment for all materials and equipment; and full payment of all wages of labor.

The form of the Contract Bond shall be acceptable to both the Department and the Division of Purchases. In the event the surety fails or becomes financially insolvent, the successful bidder shall file a new Bond in the amount designated by the Department within thirty (30) days of such failures or insolvency.

The Bond submitted to the Department shall be provided by a surety both acceptable to the Department and licensed and authorized to conduct business in the State of Rhode Island. All surety companies must be listed with the Department of the Treasury, Fiscal Services, Circular 570, (Latest Revision published by the Federal Register). Subsequent to award of Contract, the Department or Division of Purchases may call for additional security as required. Changes, additions, and modifications to the Contract may be made without the consent of surety.

103.06 EXECUTION AND APPROVAL OF THE CONTRACT. The Contract shall be executed by the successful bidder, hereinafter referred to as the Contractor, in accordance with the instructions contained in the Notice of Tentative Award. At the specified time and place, the Contractor shall deliver the Contract Bond and required Certificates of Insurance, execute the Contract Agreement, and comply with all other stipulations set forth in said notice.

Receipt by the Contractor of the executed Contract Agreement and a Purchase Order signed by the Director of the Department and/or the Purchasing Agent and the State Controller constitutes the official "Award" of the Contract.

The Contract execution date may be extended by mutual agreement of the Department and the successful bidder.

103.07. FAILURE TO EXECUTE CONTRACT.

a. Failure of State to Execute Contract. If the Contract is not executed within fifteen (15) calendar days following execution of the Contract Agreement and Bond by the Contractor, said Contractor shall have the right to withdraw its Proposal without penalty.

b. Failure of the Bidder to Execute Contract. Failure of the successful bidder to execute the Contract Agreement and Contract Bond, deliver the required Certificates of Insurance; and comply with other stipulations within fifteen (15) calendar days of receipt of the Notice of Tentative Award shall be considered revocation of said notice and require forfeiture of the Proposal Guaranty to the State. Such forfeiture shall not be considered a penalty, but rather a liquidation of damages sustained by the State.

Furthermore, the Department will not issue or receive subsequent proposals for construction work from a bidder who fails to execute a Contract until said bidder demonstrates its ability to obtain the necessary bonding and insurance coverage to the complete satisfaction of the Department.

In the event a Contract is not executed with the first-designated responsible bidder, the Department may either award the Contract to the next lowest responsible bidder or reject all bids and readvertise the Project for the purpose of soliciting new Proposals.

103.08 ESCROW OF BID DOCUMENTATION. The placing in escrow of bid documentation in accordance with this Section shall be required only when specifically called for in the Notice to Contractors. Otherwise, this Section shall not apply.

a. Scope and Purpose. The purpose of this Specification is to preserve the bid documents of the Contractor for use by the parties in any claims or litigation between the Department and Contractor arising out of this Contract.

The Contractor shall submit to the Department a legible copy of bid documentation used to prepare the bid for this Contract. Such documentation shall be placed in escrow with a banking institution or other bonded document storage facility and preserved by that institution/facility as specified in the following Sections of this clause.

b. Submittal and Return of Bid Documentation. Prior to execution of the Contract, the Contractor shall submit to the Department the required bid documentation in a sealed container. The container shall be clearly marked "Bid Documentation" and shall also show on the face of the container the Contractor's name and address, the date of submittal, the Project Number, the Contract Number, and Project Name.

c. Affidavit. In addition to the bid documentation, the Contractor shall submit an affidavit, signed under oath by a representative of the Contractor authorized to execute bidding proposals, listing each bid document submitted by author, date, nature, and subject matter. The affidavit shall attest that the affiant has personally examined the bid documentation, that the affidavit lists all of the documents relied upon by the Contractor in preparing its bid for this project, and that all such bid documentation is included in the submission to the Department.

d. Duration and Use. The Department and the Contractor will jointly deliver the sealed container and affidavit to a banking institution or other bonded document storage facility selected by the Department for placement in a safety deposit box, vault or other secure accommodation.

The agreement with the document depository shall reflect that the bid documentation and affidavit shall remain in escrow during the life of the Contract or until the Contractor notifies the Department of his intention to file a claim or initiate litigation against the Department related to the Contract. Notification of the Contractor's intention to file a claim, or initiation of litigation against the Department, shall be sufficient grounds for the Department to obtain the release and custody of the bid documentation. In the absence of such action and provided that the Contractor has signed the final Standard Release Form, the Department shall instruct the document depository to release the sealed container to the Contractor.

In accordance with its representation that the sealed container placed in escrow contains all of the materials relied upon by the Contractor in preparing its bid, the Contractor agrees to waive its right to use any bid documentation other than that placed in escrow in disputes arising out of this Contract.

e. Refusal or Failure to Provide Bid Documentation. Failure to provide bid documentation in accordance with the requirements of this Section shall be considered revocation of the notice of award and forfeiture of the Proposal Guaranty to the State.

f. Confidentiality of Bid Documentation. The bid documentation and affidavit in escrow are, and will remain, the property of the Contractor. The Department has no interest in, or right to, the bid documentation unless notification of the intention to file claim is received or litigation ensues between the Department and Contractor. In the event of such notification or litigation, the bid documentation and affidavit shall become the property of the Department; provided, however, that these materials, and all copies made by the Department, shall be returned to the Contractor at the conclusion of litigation, or final resolution of all outstanding claims, upon execution of a final release. Moreover, the Department shall make every reasonable effort to insure that bid documentation to which it has gained access will remain confidential within the Department and will not be made available to anyone outside the Department, or used by a former Department employee.

g. Cost and Escrow Instructions. The cost of the escrow will be borne by the Department. The Department will provide escrow instructions to the document depository consistent with this clause.

There will be no separate payment for compilation of the data, container or cost of verification of the bid documentation. All costs shall be included in the overall Contract bid price.

SECTION 104

SCOPE OF WORK

104.01 INTENT OF CONTRACT. The intent of the Contract is to provide for the construction and completion in every detail of the work as described. The Contractor shall furnish all labor, materials, equipment, tools, transportation and supplies required to complete the work, all in accordance with the Plans, Specifications and terms of the Contract.

104.02 CHANGES IN THE CONTRACT.

a. Right to Change. The Engineer reserves the right to make changes in the Contract at any time during the progress of the work as are necessary to satisfactorily complete the Project. Such changes shall not invalidate the Contract nor release the Surety. The Contractor agrees to perform the work as directed by the Engineer. Any costs applicable to such changes will be paid for by the execution of an appropriate Contract Modification.

b. Causes for Changes. Changes in the Contract may result from any of the following causes:

1. Differing site conditions.

2. Alterations in the Plans or Details; additions to, reductions in, or elimination of an existing item of work contained in the Proposal.

3. Extra or unforeseen work for which there is no item of work in the Proposal.

4. Suspension of the work for which delay damages are reasonable.

5. Significant changes in the character of the work.

104.03 DIFFERING SITE CONDITIONS. During the progress of the work, if subsurface or latent physical conditions are encountered at the site differing materially from those indicated in the Contract or if unknown physical conditions of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in the work provided for in the Contract, are encountered at the site, the party discovering such conditions shall promptly notify the other party in writing of the specific differing conditions before the site is disturbed and before the affected work is performed.

Upon written notification, the Engineer will investigate the conditions, and if it is determined that the conditions materially differ and cause an increase or decrease in the cost or time required for the performance of any work under the Contract, an adjustment, excluding anticipated profits, will be made

and the Contract modified in writing accordingly. The Engineer will notify the Contractor of the determination whether or not an adjustment of the Contract is warranted.

No Contract adjustment which results in a benefit to the Contractor will be allowed unless the Contractor has provided the required written notice.

No Contract adjustment will be allowed under this clause for any effects caused on unchanged work.

104.04 ALTERATIONS IN THE PLANS OR DETAILS. The Engineer may order changes in the Plans or Details, increase, reduce, or eliminate any Contract work item deemed necessary to satisfactorily complete the Project. Should such alterations in the Contract result in changes in the quantities of work to be performed, the Contractor shall complete such altered quantities in the same manner prescribed for the corresponding unaltered quantities. Unless otherwise provided for under **Subsection 104.07; Significant Changes in the Character of the Work**, such altered work shall be paid for at the same unit prices as for the corresponding unaltered items of work.

a. Prefabricated Materials. The Engineer may find it necessary to decrease or eliminate items of work that involve prefabricated materials which are not considered stock commercial items. In the event fabrication of such materials was started or completed before the Contractor is advised of the decrease or elimination of the items in question, the Department may:

1. Upon verification, reimburse the Contractor for the fabrication cost, including material cost less salvage value; or

2. Instruct the Contractor to have the fabricated material delivered to the project to be placed in the care of the Engineer for subsequent use by the State on other work. Payment for such material will be made in accordance with **Subsection 109.06; Partial Payments**.

104.05 EXTRA WORK. The Contractor shall perform extra work, for which there is no price included in the Contract, whenever it is deemed necessary or desirable to complete the work as contemplated. Such work shall be performed in accordance with the Specifications and as directed, and will be paid for as provided under **Subsection 109.04; Differing Site Conditions, Changes, Extra Work, and Force Account Work**.

104.06 SUSPENSIONS OF WORK ORDERED BY THE ENGINEER. If the performance of all or any portion of the work is suspended or delayed by the Engineer in writing for an unreasonable period of time (not originally anticipated, customary, or inherent to the construction industry) and the Contractor believes that additional compensation and/or Contract time is due as a result of such suspension or delay, the Contractor shall submit to the Engineer in writing a request for adjustment within seven calendar days of receipt of the notice to resume work. The request shall set forth the reasons and support for such adjustment.

Upon receipt, the Engineer will evaluate the Contractor's request. If the Engineer agrees that the cost and/or time required for the performance of the Contract has increased as a result of such suspension and the suspension was caused by conditions beyond the control of and not the fault of the Contractor, its suppliers, or subcontractors at any approved tier, and not caused by weather, the Engineer will make an

adjustment (excluding profit) and modify the Contract in writing accordingly. The Contractor will be notified of the Engineer's determination whether or not an adjustment of the Contract is warranted.

No Contract adjustment will be allowed unless the Contractor has submitted the request for adjustment within the time prescribed.

No Contract adjustment will be allowed under this clause to the extent that performance would have been suspended or delayed by any other cause, or for which an adjustment is provided for or excluded under any other term or condition of this Contract.

104.07 SIGNIFICANT CHANGES IN THE CHARACTER OF THE WORK. The Engineer reserves the right to make in writing at any time during the work, such changes in quantities and such alterations in the work as are necessary to satisfactorily complete the project. Such changes in quantities and alterations shall not invalidate the Contract nor release the surety, and the Contractor agrees to perform the work as altered.

If the alterations or changes in quantities significantly change the character of the work under the Contract, whether such alterations or changes are in themselves significant changes to the character of the work or by affecting other work cause such other work to become significantly different in character, an adjustment, excluding anticipated profits, will be made to the Contract. The basis for the adjustment shall be agreed upon prior to the performance of the work. If a basis cannot be agreed upon, then an adjustment will be made either for or against the Contractor in such amount as the Engineer may determine to be fair and equitable.

If the alterations or changes in quantities do not significantly change the character of the work to be performed under the Contract, the altered work will be paid for as provided elsewhere in the Contract.

a. Circumstances for Significant Change. The term "significant change" shall be construed to apply only to the following circumstances:

1. When the character of the work as altered differs materially in kind or nature from that involved or included in the original proposed construction or;

2. When a major item of work, as defined elsewhere in the Contract, is increased in excess of 125 percent or decreased below 75 percent of the original Contract quantity. Any allowance for an increase in quantity shall apply only to that portion in excess of 125 percent of original Contract item quantity, or in case of a decrease below 75 percent, to the actual amount of work performed.

104.08 MAINTENANCE OF TRAFFIC. Unless otherwise provided, the Contractor shall maintain the road undergoing improvement open to all traffic during the work of the Contract. Where so provided on the Plans, the Contractor may bypass traffic over an approved detour route. Additional detours not shown on the Plans may be employed only if plans for the detours are designed, submitted, reviewed, approved, and implemented in accordance with the requirements indicated in the Transportation Management Plan and such plans receive the written approval of the local City/Town Public Works Director. Detours of a short-term nature, which may be implemented only during the Contractor’s scheduled hours of operation, and which must be removed at the close of the day’s operations, shall require a 24-hour advance notice and approval of the Engineer. The Contractor shall keep the portion of the project being used by public traffic, whether it be through or local traffic, in a condition that shall safely and adequately accommodate

such traffic. The Contractor shall furnish, erect and maintain all temporary traffic control devices in accordance with the Manual on Uniform Traffic Control Devices for Streets and Highways, latest Edition.

The Contractor shall bear all expense of maintaining traffic over the section of road undergoing improvement without direct compensation, except as provided below:

a. Special Detours. When the Contract contains items for "maintenance of detours" or "removing existing structures and maintaining traffic," the payment for such items shall cover all cost of constructing and maintaining detour or detours, including the construction of temporary bridges and accessory features and the subsequent legal removal of the same. The failure or refusal of the Contractor to construct detours at the proper time and to maintain same in working condition shall be sufficient cause for suspending the work until such detours are provided in satisfactory condition for use by public traffic. Right-of-way for temporary roads or bridges will be furnished by the Department.

b. Maintenance of Traffic During Suspension of Work. During any suspension of the work, the Contractor shall make passable and shall open to traffic those sections of the project, together with temporary roadways or portions thereof as may be agreed upon between the Contractor and the Engineer, for the temporary accommodation of traffic during the anticipated period of suspension. Thereafter, and until an issuance of an order for the resumption of construction operations, the maintenance of the temporary roadways and sections of the project will be the responsibility of the Department. When work is resumed, the Contractor shall replace or renew any work or materials lost or damaged because of such temporary use of the project; remove to the extent directed by the Engineer any work or materials used in the temporary maintenance thereof by the State; and complete the project in every respect as though its prosecution had been continuous and without interferences. Additional work caused by such suspension, for reasons beyond the control of the Contractor, will be paid for by the State in accordance with **Subsection 109.04; Differing Site Conditions, Changes, Extra Work and Force Account Work**.

c. Maintenance Directed by the Engineer. If the Engineer directs special maintenance for the benefit of the traveling public, then the Contractor will be paid on the basis of prevailing unit prices or in accordance with **Subsection 104.05; Extra Work**. The Engineer will be the sole judge of work to be classed as special maintenance.

Detours or routes used exclusively by the Contractor for hauling materials and equipment shall be constructed and maintained at its own expense. In order to provide for the safety, comfort, and well-being of residents of heavily populated residential areas, the Contractor shall select haul routes between the project and material sources that will minimize disturbance to such residents. The Contractor shall submit for the Engineer's review its planned route of haul and its plan for minimizing the adverse effect of such hauling operations on local residents. It shall be the responsibility of the Contractor to obtain all necessary permits, approvals and licenses and to comply with the ordinances, rules and regulations of the local community concerning haul routes and detours, all at no expense to the Department.

The Department reserves the right to select alternative haul routes, to divide the hauling traffic over several routes, and to impose such other restrictions it deems necessary to minimize the impact of the hauling operation on local residents.

The Contractor shall not store barricades, material, or equipment in a manner that would impede or impair the safety of the traveling public.

d. Maintenance for Traffic Flow-Utility Work. The Contractor shall provide, as part of the Contract, construction signing in accordance with the Manual on Uniform Traffic Control Devices for all utility work performed directly by utility companies, municipalities, or their respective subcontractors.

Also included is the provision by the Contractor of flaggers, traffic persons, and the setting up, maintaining, and moving of signs, all in accordance with applicable provisions contained in **PART 900** of these Standard Specifications.

104.09 MAINTENANCE OF PUBLIC ACCESS. Unless otherwise provided, the Contractor shall maintain existing streets, highways, roads, private walks and sidewalks which may be involved with the Project, open for vehicular and/or pedestrian traffic. The Contractor shall also provide and maintain in a safe condition temporary approaches, crossings, and intersections with trails, roads, streets, businesses, parking lots, residences, garages, farms, and other features as may be necessary, and at its own expense and as directed by the Engineer.

With respect to maintaining public access as described above, the Contractor will not be required to remove snow.

If the Engineer decides that the interests of the public and/or abutting property owners so require, the Contractor shall construct plank crossings, or other such approved temporary crossings, over trenches in streets, roads, or private ways. All such temporary crossings shall be provided as directed by the Engineer.

104.10 RIGHTS IN AND USE OF MATERIALS FOUND ON THE PROJECT. The Contractor, with the approval of the Engineer, may use on the project such stone, gravel, sand, or other material determined suitable by the Engineer, as may be found in the excavation and will be paid both for the excavation of such materials at the corresponding Contract unit price and for the pay item for which the excavated material is used. The Contractor shall replace at its own expense with other acceptable material all of that portion of the excavation material so removed and used which was needed for use in the embankments, backfills, approaches, or otherwise. No charge for the materials so used will be made against the Contractor. The Contractor shall not excavate or remove any material from within the highway location which is not within the grading limits, as indicated by the slope and grade lines, without prior written authorization from the Engineer.

104.11 FINAL CLEANING-UP. Prior to any inspections performed subsequent to the Contractor's "Notice of Substantial Completion," all areas occupied by the Contractor in connection with the work shall be cleaned of all rubbish, excess materials, temporary structures, and equipment. All parts of the work shall be left in an acceptable condition.

The cost of the final clean-up shall be incidental to other items of work and no separate payment shall be made.

The Contractor shall remove its equipment, materials and other obstacles from the project right-of-way and from property adjacent to the project site which is not owned or controlled by the Contractor within thirty (30) days after completion of the Project. The Contractor shall clean and remove all cement streaks or drippings, paint smears or drippings, rust stains, oil, grease, bituminous materials, dirt, and other foreign materials on or in any structure, curb, gutter, median or gore marker due to its operation.

104.12 RAILWAY-HIGHWAY PROVISIONS. If the Contract requires that materials be hauled across the tracks of any railway, the Department will arrange with the railway for new crossings or for the use of any existing crossings. If the Contractor elects to use crossings other than those specified in the Contract, the Contractor shall make arrangements for the use of the crossings.

Work to be performed by the Contractor on the railway Right-of-Way shall be performed to avoid interference with the movement of trains or traffic of the railway company. The Contractor shall avoid accidents, damage, or unnecessary delay or interference with railway trains and other property.

104.13 CONSTRUCTION OVER OR ADJACENT TO NAVIGABLE WATERS. Work over, on, or adjacent to navigable waters shall be so conducted so that free navigation of the waterways will not be interfered with and that the existing navigable depths will not be impaired except as allowed by permit issued by the U.S. Coast Guard or the U.S. Army Corps of Engineers, as applicable.

104.14 CONTRACTOR'S RESPONSIBILITY FOR THE WORK. Until substantially complete, the Contractor shall be responsible and shall protect all work against injury or damage from all causes whether arising from the execution or the non-execution of the work. At the Contractor's expense, the Contractor shall rebuild, repair, restore, and make good all losses, injuries, or damages to any portion of the work from any cause except those beyond the control of and without the fault or negligence of the Contractor, including but not restricted to acts of God, such as earthquake, tidal wave, tornado, hurricane, or other cataclysmic phenomenon of nature, or acts of the public enemy or of governmental authorities.

In case of suspension of work from any cause whatsoever, the Contractor shall be responsible for the project and shall take such precaution as may be necessary to prevent damage to the project, provide for normal drainage and shall erect any necessary temporary structures, signs, or other facilities at its expense. During such period of suspension of work, the Contractor shall properly and continuously maintain in an acceptable growing condition all living material in newly established plantings, seedings, and soddings furnished under his Contract, and shall take adequate precautions to protect new tree growth and other important vegetative growth against injury.

All costs associated with the work described in this Subsection shall be borne by the Contractor, unless otherwise provided, under **Subsection 104.03; Differing Site Conditions**.

104.15 ENVIRONMENTAL PROTECTION. The Contractor shall comply with all Federal, State, and local laws and regulations controlling pollution of the environment. Pollution of streams, lakes, ponds, and reservoirs with fuels, oils, bitumens, chemicals, or other harmful materials, and pollution of the atmosphere from particulate and gaseous matter shall be avoided.

When work areas or pits are located in or adjacent to live streams, such areas shall be separated from the main stream by a dike or barrier to keep sediment from entering a flowing stream. Care shall be taken during the construction and removal of such barriers to minimize siltation of the stream.

Water from aggregate washing or other operations containing sediment shall be treated by filtration, settling basins, or other means sufficient to reduce the sediment content to not more than that of the stream or lake into which it is discharged.

Other requirements relating to temporary and permanent erosion and water pollution controls are set forth in **SECTIONS 206 through 210**, respectively, of these Specifications.

a. Plant and Pest Control Requirements. The United States Department of Agriculture has advised that soil and soil-moving equipment operating in regulated areas of certain counties will be subject to plant and pest quarantine regulations. In general, these regulations provide for cleaning soil from equipment before it is moved from regulated areas. Complete information may be secured from appropriate divisions of the Rhode Island Department of Environmental Management and the United States Department of Agriculture.

Contractors shall comply with these regulations where applicable to the State of Rhode Island.

SECTION 105

CONTROL OF WORK

105.01 AUTHORITY OF THE ENGINEER. The Engineer will decide all questions related to the quality and acceptability of materials furnished; work performed; and the rate of progress of the work; questions regarding the interpretation of the Contract Documents; and questions as to the acceptable fulfillment of the Contract by the Contractor.

The Engineer will have the authority to suspend the work completely or in part due to the failure of the Contractor to correct conditions unsafe for the workers or the general public; for failure to carry out provisions of the Contract; for failure to carry out orders; for such periods necessary due to unsuitable weather; for failure to correct damages to public or private properties caused by the Contractor and/or its Subcontractors, for conditions considered unsuitable for the prosecution of the work or for any other condition or reason determined to be in the State's interest.

105.02 PLANS AND SHOP DRAWINGS. Plans will show details of all structures, lines, grades, typical cross sections of the roadway, location and design of all structures and a summary of items appearing on the Proposal. Bridge plans will either show all dimensions and details necessary for complete construction or such information that when supplemented by additional field data gathered by the Contractor will enable the Contractor to prepare complete shop drawings.

The Contractor shall keep one set of plans available at the site at all times, and shall provide approved shop drawings to the Engineer upon request.

All shop drawings will be submitted in a timely fashion such that the Contractor’s approved schedule will not be adversely impacted by the submittal process. Shop drawings shall consist of such detailed plans required to control the work that are not included in the Plans furnished by the Department. They shall include, but not be limited to, stress sheets, erection plans, falsework plans, sheeting plans, cofferdam plans, bending diagrams for reinforcing steel or any other supplementary plans or similar data required of the Contractor. The Contractor shall submit eight (8) sets of shop drawings to the Engineer and one set to the design consultant of record. Shop drawings shall be accompanied by eight (8) sets of design computations, cuts from manufacturers' catalogs, and/or supporting technical bulletins.

Engineering shop drawings and design computations shall be stamped only by a Rhode Island Registered Professional Engineer. The stamping of Plans for professional design shall be in accordance with the applicable requirements of the Rhode Island Board of Registration for Professional Engineers, or other Boards of Professional Registration, as applicable.

Within forty-five (45) calendar days of submission, all shop drawings shall be reviewed by the Engineer and returned to the Contractor for appropriate action. Shop drawings that are found to be erroneous, lacking information necessary to control construction, or not in conformance with accepted design criteria will be disapproved and returned to the Contractor. The Contractor shall address the Engineer's comments and resubmit revised shop drawings and/or design computations. The Contractor will not be allowed any increase in Contract time for the time taken by the Contractor to submit revised shop drawings caused by an erroneous submission, or by a previous submission either lacking the information necessary to control construction, or not conforming to accepted design criteria. Also, the time taken by the Engineer to review the revised shop drawings does not constitute justification for additional Contract time.

Shop drawings must be approved by the Engineer prior to performance of the work involved. Such approval shall not relieve the Contractor of any responsibility under the Contract for the successful completion of the work.

Unless otherwise specified in the Contract Documents, the Contract price will include the cost of furnishing all shop drawings.

105.03 CONFORMITY WITH PLANS AND SPECIFICATIONS. Work performed and materials furnished shall be in reasonably close conformity with the lines, grades, cross sections, dimensions and material requirements, including tolerances, specified in the Contract Documents.

In the event the Engineer finds the materials furnished, work performed or the finished product are not in reasonably close conformity with the Contract Documents, but that reasonably acceptable work has been produced, THE Engineer will determine if the work should be accepted and remain in place. If accepted, the Engineer will document the basis of acceptance by Contract modification which will provide for an appropriate adjustment in the Contract price for such work or materials as necessary to support this determination.

"Reasonably close conformity" means compliance with reasonable and customary manufacturing and construction tolerances where working tolerances are not specified. Where working tolerances are specified, reasonably close conformity means compliance with such working tolerances. Without detracting from the complete and absolute discretion of the Engineer to insist upon such tolerances as establishing reasonably close conformity, the Engineer may accept variations beyond such tolerances as reasonably close conformity where such variations will not materially affect the value or utility of the work or the interests of the State.

105.04 COORDINATION OF PLANS, SPECIFICATIONS, SUPPLEMENTAL SPECIFICATIONS, AND SPECIAL PROVISIONS. The Standard Specifications, Supplemental Specifications, Plans, Special Provisions, and Contract Addenda are essential parts of the Contract; and a requirement occurring in one is as binding as though occurring in all. They are intended to be complementary and to describe and provide for a complete work. In case of discrepancy, calculated dimensions will govern over

scaled dimensions; Plans will govern over Standard and Supplemental Specifications; Supplemental Specifications will govern over Standard Specifi-cations; and Special Provisions will govern over Standard Specifications, Supplemental Specifi-cations and Plans.

The Contractor shall take no advantage of any apparent error or omission in the Contract Documents. If the Contractor discovers such an error or omission, the Engineer shall be promptly notified. The Engineer will then make such corrections and interpretations necessary to fulfill the intent of the Contract Documents.

105.05 COOPERATION BY CONTRACTOR. The Department will supply the Contractor with a Contract Award Booklet containing a Contract Award compact disk (CD), from which the plans, specifications, contract addenda and other contract documents may be printed. The Contractor will be required to keep one set of printed copies of the Contract Documents available on the project site at all times.

The Contractor shall give the work the constant attention necessary to facilitate progress and shall cooperate fully with the Engineer, the Department's Resident Engineer and inspectors, and other Contractors.

The Contractor shall have on the project site as its agent, a competent superintendent capable of reading and thoroughly understanding the Contract Documents and experienced in the type of work being performed. The superintendent shall receive orders or instructions from the Engineer, shall be authorized to act for the Contractor on the work, and shall have full authority to execute orders or directions of the Engineer without delay.

The Contractor shall promptly supply, irrespective of the amount of work sublet, the necessary materials, equipment, tools, labor, and other incidentals to complete the Contract.

a. Causes for Removal. The Engineer may remove the superintendent from the project at any time if:

1. The performance of the superintendent is unsatisfactory; or

2. The superintendent is uncooperative in his relationship with the Engineer.

105.06 COOPERATION WITH UTILITIES. The Department will notify all utility companies, all pipe line owners, or other parties affected, and endeavor to have all necessary adjustments of public or private utility fixtures, pipe lines, and other appurtenances within or adjacent to the limits of construction, made as soon as practicable.

Water lines, gas lines, wire lines, service connections, water and gas meter boxes, water and gas valve boxes, light standards, cableways, signals, and all other utility appurtenances within the limits of the proposed construction in which the respective owners hold no private easements are to be relocated or adjusted by said owners in accordance with executed Construction and Maintenance Agreements/Utilities.

It is understood that the Contractor has considered in its Proposal all of the permanent and temporary utility facilities in their present or relocated positions as specified in the Contract and as revealed by site investigation. No additional compensation will be allowed the Contractor for any delays,

inconvenience, or damage sustained by it due to any interference caused by such facilities or the operation of relocating them, unless otherwise provided for in **Subsection 104.03; Differing Site Conditions**.

In general, the Contract will indicate those various utility items which are to be relocated or adjusted by the utility owner in accordance with Construction and Maintenance Agreements, and those which are to be relocated or adjusted by the Contractor. In this latter case, all underground construction required under the Contract for new or existing electric and/or telephone related facilities shall be performed by a contractor approved by the respective utility company. The Contractor may perform this work if it has been so-approved; otherwise, the Contractor shall retain a firm that has been approved for such work. The work involved would include all adjustments to utility manholes, frames and grates, as well as the utility lines themselves. Prior to the preconstruction conference, the Contractor shall submit to the Engineer written statements from the respective utility companies that the firm or firms selected by the Contractor are approved for such work. See **Special Provision Code 105.2000.**

Prior to commencing work, the Contractor shall make arrangements to protect the properties of railway, telegraph, telephone, water, gas, and power companies, or other property, from damage that could result in considerable expense, loss, or inconvenience.

In addition, the Contractor shall notify each utility owner and/or municipality whose facilities might be affected by its work 24 hours in advance of the commencement of such work. This notification shall also request the respective utility owner and/or municipality to assign a representative to be present at the site of the work during the period of the Contractor's operations.

The locations and depths of existing utilities as shown on the Plans are approximate and should not be relied upon by the Contractor. The Contractor shall check and verify the location of all existing utilities, both underground and overhead, before proceeding to commence the work or order materials. Excavation shall be in accordance with all statutes, ordinances, and regulations of the Municipality, State or Federal Government that may be applicable. The Contractor is specifically required to follow the Dig Safe process. Damage to existing utilities which are shown on the Plans or located by the respective utilities in accordance with the Dig Safe process shall be the sole responsibility of the Contractor.

The Contractor shall cooperate with the utility owners in the removal and rearrangement of any underground or overhead utilities in order that these operations may progress in a reasonable manner; that duplication of rearrangement work may be reduced to a minimum; and that services rendered by the utility owners will not be unnecessarily interrupted.

In the event of interruption to water or utility services as a result of accidental breakage or of being exposed or unsupported, the Contractor shall promptly notify the proper authority and shall cooperate fully in the restoration of such services.

If water service is interrupted, repair work shall be continuous until the service is restored. No work shall be undertaken around fire hydrants until provisions for continued service have been approved by the local fire authority.

The Contractor shall prevent damage to pipes, cables, and other utilities. Repairs to damaged utilities caused by carelessness or omissions on the Contractor's part will be corrected at the Contractor's expense. The damaged facilities shall be restored to a condition similar or equal to that existing before the damage occurred. If the Engineer determines that adjustment or relocation of utilities is necessary to accommodate construction, the Engineer will make necessary arrangements with the owner if the work is not otherwise provided for in the Contract.

If the Engineer determines that adjustment of utility facilities is necessary to accommodate construction, and the adjustment work is not provided for in the Contract, the Contractor will be paid for the work in accordance with **Subsection 109.04; Differing Site Conditions, Changes, Extra Work, and Force Account Work**.

a. Contractor Coordination with U.S. Postal Service. The Contractor shall notify and coordinate with the U.S. Postal Service in situations where existing U.S. Postal Boxes (mail drop/collection boxes) within the limits of the Contract are to be removed and reset to allow for sidewalk/curbing construction. This requirement applies only in the case of standard U.S. Postal Service main drop boxes; it is not applicable for the removal and resetting or replacement of private mailboxes. The removal and resetting of U.S. Postal Service mail drop boxes must be conducted only by the U.S. Postal Service, and therefore, a reasonable time allowance must be provided by the Contractor to allow the Postal Service to complete the removal prior to start of construction. Finally, the Contractor shall coordinate with the Post Office when construction is complete and acceptable such that the boxes may be reset.

b. Contractor Coordination with Narragansett Bay Commission. The Contractor must obtain a sewer facility alteration permit from the Narragansett Bay Commission prior to undertaking any work that affects sanitary sewer facilities that fall within NBC jurisdiction. The permit will be issued through the NBC and can be obtained at the location indicated in **Special Provision Code 105.1000** of the Contract.

105.07 COOPERATION BETWEEN CONTRACTORS. The Department reserves the right to contract for, and perform other or additional work on or near the work covered by the Contract.

When separate contracts are let within the limits of any one project, each Contractor shall conduct its work without interfering or hindering the progress or completion of the work being performed by other contractors. Contractors working on the same project shall cooperate with each other as directed by the Engineer.

Each Contractor involved shall assume all liability, financial or otherwise, in connection with its contract and shall protect and save harmless the Department from any and all damages or claims that may arise because of inconvenience, delay, or loss experienced because of the presence and operations of other contractors working within the limits of the same project unless otherwise provided for under **Subsection 104.03; Differing Site Conditions**.

The Contractor shall arrange the work and shall place and dispose of the materials being used without interfering with the operations of the other contractors within the limits of the same project. The work shall be coordinated with that of the others in an acceptable manner and shall be performed in proper sequence with that of the other contractors.

105.08 CONSTRUCTION STAKES, LINES, AND GRADES. The Contractor will set construction stakes establishing lines, slopes, profile grades, centerline and benchmarks for roadwork, bridge work, culvert work, protective and accessory structures~~,~~ and appurtenances. These stakes and marks shall constitute the field control by which the Contractor shall establish other necessary controls and perform the work.

The contractor will maintain construction lines, points and grade staking to assure accurate and proper control of the work and to verify final grades and construction lines. The Contractor shall be held responsible for preserving all stakes and marks, and if the stakes or marks are destroyed or disturbed by the Contractor, the responsibility of replacing them will be borne by the Contractor at his own expense.

The Contractor will be responsible for the accuracy of lines, slopes, grades, and other engineering work set forth under the contract documents and the provisions of **SECTION 934; FIELD CONTROL AND CONSTRUCTION LAYOUT.**

105.09 AUTHORITY AND DUTIES OF RESIDENT ENGINEER. As the representative of the Engineer, the Resident Engineer has immediate charge of the engineering details of each construction project, and is responsible for the administration and satisfactory completion of the project. The Resident Engineer is delegated commensurate authority by the Department and is, thereby, authorized to reject defective material and to suspend any work that is being improperly performed. The Resident Engineer is authorized to make changes that involve increases or decreases in quantities not greater than ten-percent of the corresponding values that appear in the Proposal. The Resident Engineer is not authorized to make changes in any design element or project specification; or to make increases or decreases in quantities greater than ten-percent of the corresponding values that appear in the Proposal.

105.10 INSPECTION OF WORK. All materials and each part or detail of the work shall be subject to inspection by the Engineer. The Engineer shall be allowed access to all parts of the work and shall be furnished with such information and assistance by the Contractor as is required to make a complete and detailed inspection.

If requested by the Engineer, the Contractor, before acceptance of the work, shall remove or uncover such portions of the finished work as may be directed. After examination, the Contractor shall restore said portions of the work to the standard required by the Contract. Should the work thus exposed or examined prove acceptable, the uncovering, removing, and replacing the covering, or making good of the parts removed will be paid for as Extra Work. Should the work so exposed or examined prove unacceptable, the uncovering, removing, and replacing of the covering, or making good of the parts removed, shall be at the Contractor's expense.

Work performed or materials used without supervision or inspection by an authorized Department representative as a result of failure of the Contractor to notify the Engineer may be ordered removed and/or replaced at the Contractor's expense.

When any unit of government or political subdivision, utility or railroad corporation is required to accept and/or pay a portion of the cost of the work covered by this Contract, its representatives shall have the right to inspect the work. Such inspection shall not make any unit of government or political

subdivision, utility, or railroad corporation a party to this Contract, and shall in no way interfere with the rights of either such party.

105.11 REMOVAL OF UNACCEPTABLE AND UNAUTHORIZED WORK. Work which does not reasonably conform to the requirements of the Contract will be considered unacceptable, unless otherwise determined acceptable under the provisions of **Subsection 105.03; Conformity with Plans and Specifications**.

Unacceptable work, whether the result of poor workmanship, use of defective materials, or damage through carelessness, found to exist prior to the final acceptance of the work, shall be removed immediately and replaced in an acceptable manner at the Contractor's expense.

Work performed contrary to the instructions of the Engineer; work performed beyond the lines and grades shown on the Plans, or as otherwise provided; or any extra work performed without authority, will be considered as unauthorized work and will not be paid for under the provisions of the Contract. Work so performed may be ordered removed and/or replaced at the Contractor's expense.

If the Contractor fails to promptly comply with any order of the Engineer made under the provisions of this Subsection, the Engineer is authorized to require unacceptable work to be remedied or removed and replaced, and unauthorized work to be removed, and to deduct the costs incurred thereby from any monies due or to become due the Contractor.

105.12 LOAD RESTRICTIONS. The Contractor shall comply with all legal load restrictions in the hauling of equipment or materials on public roads beyond the limits of the project. A special permit will not relieve the Contractor of liability for damage which may result from the moving of such equipment or materials.

The operation of equipment on hauling loads which cause damage to structures or the roadway, or to any other type of construction, will not be permitted. Handling or hauling of materials over the base course or surface course under construction shall be limited as directed by the Engineer to prevent damage to the pavement structure. No loads will be permitted on a concrete pavement, base or structure before the concrete has attained its required strength unless otherwise authorized in writing by the Engineer.

105.13 MAINTENANCE DURING CONSTRUCTION. The Contractor shall maintain the work during construction and until the project is substantially complete. This maintenance shall constitute continuous and effective work prosecuted day by day, with adequate equipment and forces to the end that the roadway or structures are kept in satisfactory condition.

If the Contract requires the placing of a course upon a course or subgrade previously constructed, the Contractor shall maintain the previous course or subgrade during all construction operations.

Cost of maintenance work during construction and before the project is substantially completed is contained within the Contract unit prices of the various pay items and the Contractor will not be paid an additional amount.

105.14 OPENING SECTIONS OF PROJECT TO TRAFFIC. Opening of sections of the work to traffic prior to completion of the entire Contract may be desirable from a traffic service standpoint; or may be necessary due to conditions inherent in the work, or by changes in the Contractor's work schedule; or necessary due to conditions or events unforeseen at the time of the Contract award. Such openings to traffic shall be made when ordered by the Engineer. Under no condition shall the openings constitute acceptance of the work or a waiver of any provisions of the Contract.

The Contract will state which sections shall be opened to traffic prior to completion of the Project. On any section opened by order of the Engineer, whether covered in the Contract or not, the Contractor shall not be required to assume any expense in maintaining the road for such traffic. Such expense will be borne by the Department, or compensated for in accordance with **Subsection 109.04; Differing Site Conditions, Changes, Extra Work and Force Account Work**.

If, however, the Contractor is dilatory in completing shoulders, drainage structures, or other features of the work, the Engineer may notify the Contractor in writing and establish a period of time in which the work should be completed. If the Contractor is dilatory, or fails to make a reasonable effort toward completion in this period of time, the Engineer may order all or a portion of the project opened to traffic. On sections which are so ordered to be opened, the Contractor shall conduct the remainder of the construction operations to cause the least obstruction to traffic. Costs incurred due to the dilatory nature of the Contractor's response to instructions of the Engineer shall be borne solely by the Contractor.

On any section opened to traffic under the above conditions, whether stated in the Contract or opened by necessity of Contractor's operations, or unforeseen necessity, damage to the highway not attributable to traffic that occurs (except slides) shall be repaired at the expense of the Contractor. The removal of slides shall be done by the Contractor on a basis determined by the Engineer prior to removal.

Unless otherwise specified, the Contractor shall schedule pavement removal such that no location shall remain unpaved for longer than ten (10) working days. This means that once the Contractor commences with the removal of existing full depth pavement from any location where traffic flow is to be maintained, he must restore the roadway with no less than a full depth bituminous base course at that particular location within 10 working days. In the case of partial depth pavement removal (cold planning/milling), the Contractor shall schedule the pavement removal such that no location shall remain without a new bituminous asphalt layer for longer than seven (7) calendar days.

105.15 FURNISHING RIGHT-OF-WAY. The Department is responsible for securing Rights-of-Way in advance of construction. Exceptions will be indicated in the Contract.

105.16 FAILURE TO MAINTAIN ROADWAY OR STRUCTURE. If the Contractor fails to comply with the provisions of **Subsection 105.13; Maintenance During Construction**, the Engineer will immediately notify the Contractor of such non-compliance. If the Contractor fails to remedy unsatisfactory maintenance within 24 hours after receipt of such notice, the Engineer may immediately proceed to maintain the project. The entire cost of this maintenance will be deducted from monies due or to become due the Contractor.

105.17 ACCEPTANCE.

a. Partial Acceptance. When the Contractor substantially completes a unit or portion of the work in accordance with the definition contained in **Subsection 101.71; Substantial Completion**, the Contractor may request an inspection of that unit or portion of the project. The Engineer's inspection shall disclose the following:

1. Work not started, but required to be completed.

2. Incomplete work, the completion of which is required.

3. Unsatisfactory work, the correction of which is required.

The Engineer shall provide the Contractor with a report containing the results of this inspection along with instruction for completing the construction of the unit or portion of the work under consideration. The Contractor shall immediately comply with these instructions. Upon completing and correcting the work, the Contractor may request another inspection.

If, upon completion of this second inspection, the Engineer finds that the unit or portion of the work has been satisfactorily completed in compliance with the Contract, the Engineer may accept that unit or portion of the work as physically completed, and the Contractor may be relieved of further responsibility for such unit or portion of the work, provided that the Contractor agrees to deliver full documentation, certificates and proofs of compliance for said work during final acceptance.

If, however, during this second inspection the Engineer finds any incomplete or unsatisfactory work, no partial acceptance will be granted, and acceptance of the unit or portion of the work must await the final acceptance of the entire project.

Partial acceptance shall not void or alter any of the terms or provisions of the Contract.

b. Final Acceptance. Final acceptance of the project will be made by the Engineer on behalf of the State when the Contractor has completed the project in full accordance with the definition contained in **Subsection 101.09; Completion**. The procedure for obtaining final acceptance follows:

1. When the Contractor determines that the work of the Contract is substantially completed in accordance with the definition of **Subsection 12.101.71; Substantial Completion**, the Contractor shall notify the Engineer of this fact.

2. Within 30 calendar days of the Contractor's official notice, the Engineer will schedule a time and date for an inspection.

3. The Engineer's inspection shall take place at the time and date established in subparagraph (2), above.

4. Within 60 calendar days of the inspection, the Engineer will notify the Contractor, in writing, as to the following:

(a) Any outstanding work items that remain to be completed.

(b) Any unsatisfactory work that must be corrected.

(c) The required submission of any and all executed documents, certificates, or proofs of compliance as required by the Contract.

Subparagraphs (a), (b), and (c), above, constitute the Engineer's so-called, "punch list."

5. The Contractor shall complete the work, correct unsatisfactory work, submit the required documents, and comply with all directions contained in the Engineer's "punch list" within 60 calendar days of the date of the Engineer's transmittal to the Contractor of said "punch list" except that;

If, during the progression of these 60 calendar days for the Contractor to complete the work, the date of December 15th is encountered, said progression of days shall stop, and shall not again be resumed until the date of the following April 15th is encountered, the intervening 120 days being designated as winter "shut down" time.

6. At the conclusion of the 60 calendar days for the Contractor to complete the work, the progression of which is defined above, the Engineer shall make another inspection of the work. If the Engineer determines that the work of the Contract has been satisfactorily completed in full accordance with **Subsection 101.09; Completion**, such inspection shall constitute the Final Inspection. In such event, the Engineer will make final acceptance of the project on behalf of the State and shall notify the Contractor in writing of this acceptance as of the date of the aforementioned Final Inspection.

If, however, this second inspection discloses that work remains to be completed, unsatisfactory work remains to be corrected, and documents remain to be submitted, the process will revert to that of **Para. b.4**, above, and proceed accordingly; with the additional stipulation that liquidated damages will commence on the date of the second inspection and will remain in effect until final acceptance is subsequently achieved, all as hereinafter provided for in **Subsection 108.08; Failure to Complete on Time**.

105.18 CLAIMS FOR ADJUSTMENTS AND DISPUTES.

a. Notification. If the Contractor deems that additional compensation is due for work or material not clearly covered in the Contract, the Contractor shall notify both the Engineer and the Chief of Construction Operations in writing of its intention to make claim for such additional compensation before beginning or continuing the affected work; also, the Contractor shall proceed diligently with performance of the contract pending final resolution of any request for relief, payment, claim, appeal or action arising under the contract, and comply with any decisions of the Engineer[1]. If such notification is not given, or the Contractor does not afford the Engineer proper facilities for keeping strict account of the actual costs, the Contractor thereby waives any claim for additional compensation. Notice by the Contractor, and the fact that the Engineer has kept account of the costs, shall not be construed as substantiating the validity of the claim.

b. Submission. Claims must be submitted within 120 days of substantial completion of the project. Claims submitted after 120 days will not be accepted. An equitable adjustment will be made to the Contract if the claim is found to be just.

Nothing in this Subsection shall be construed as establishing any claim contrary to the terms of **Subsections 104.02; 104.03; 104.04; 104.05; 104.06 and 104.07**.

c. Documentation of Claims. Any claim shall be in sufficient detail to enable the Engineer to determine the basis for entitlement and the resulting costs. The following minimum information must accompany each claim submitted:

1. A detailed factual statement of the claim providing all necessary dates, locations and items of work affected by the claim.

2. The date actions resulting in the claim occurred or conditions resulting in the claim became evident.

3. A copy of the "Notice of Potential Claim" must be filed for the specific claim.

4. The name and title of each Department employee knowledgeable about facts that gave rise to such claim.

5. The name and title of each Contractor or employee knowledgeable about facts that gave rise to such claim.

6. The specific provisions of the Contract which support the claim, and a statement why such provisions support the claim.

7. The identification of any pertinent documents, and the substance of any material or communications relating to the claim.

8. A statement whether the additional compensation or extension of time is based on the provisions of the Contract or an alleged breach of Contract.

9. If an extension of time is also sought, the specific days for which it is sought and the basis for such claim as determined by an analysis of the construction schedule.

10. The amount of additional compensation sought and a breakdown of that amount.

d. Certification of Claims. When submitting a claim, the Contractor must certify in writing, under oath in accordance with the formalities required as to the following:

1. The claim is made in good faith.

2. Supportive data is accurate and complete to the Contractor's best knowledge and belief.

3. The amount of the claim accurately reflects the actual cost incurred by the Contractor.

e. Auditing of Claims. All claims filed against the Department shall be subject to audit by the Department at any time following the claim filing, whether or not the claim is part of a suit pending in the courts of this State. The audit may begin on ten days notice to the Contractor, Subcontractor, or Supplier.

The Contractor, Subcontractor, or Supplier shall make a good faith effort to cooperate with the auditors and shall provide, at a minimum, access to the following documents:

1. Daily time sheets and foreman's daily reports.

2. Union agreements, if any.

3. Insurance, welfare, and benefits records.

4. Payroll register.

5. Earnings records.

6. Payroll tax returns.

7. Material invoices, purchases orders, and all material and supply acquisition contracts.

8. Material cost distribution worksheets.

9. Equipment records (list of company equipment, rates, etc.)

10. Vendor rental agreements, and subcontractor invoices.

11. Subcontractor payment certificates.

12. Canceled checks (payroll and vendors).

13. Job cost report.

14. Job payroll ledger.

15. General ledger, general journal, (if used) and all subsidiary ledgers and journals together with all supporting documentation pertinent to entries made in these ledgers and journals.

16. Cash disbursements journal.

17. Financial statements for all years reflecting the operations on this project.

18. Income tax returns whether such records are maintained by the company involved, its accountant, or others.

19. Depreciation records on all company equipment.

20. All other documents used to develop costs for the Contractor's internal purposes in establishing the actual cost of owning and operating equipment.

21. All documents which reflect the Contractor's actual profit and overhead during the time the project was being performed and for each of the five years prior to the commencement of this project.

22. All documents related to the preparation of the Contractor's bid including the final calculations on which the bid was based unless the documents are placed in escrow under other provisions of the Contract.

23. Worksheets used to prepare the claim, establishing the cost components for items of the claim including, but not limited to, labor, benefits and insurance, materials, equipment, subcontractors, and all documents which establish the time periods, individuals involved, the hours and the rates for the individuals.

105.19 PROCEDURE FOR CLAIMS AND DISPUTES. Every effort shall be made by the parties to the Contract to resolve claims and disputes in accordance with the internal procedures of the Department. If such efforts are unsuccessful, claims and disputes will be submitted to either binding arbitration or litigation for resolution in accordance with State Law.

105.20 PROJECT DELAYS.

a. General Conditions Concerning Delays. Given the nature and extent of costs arising out of work that has been delayed, and the intent of both the Contractor and the State to promptly assign responsibility for such delay and to have all associated costs as fully documented as possible, strict adherence to the provisions of this Subsection is a condition precedent to the Contractor's entitlement to additional compensation or an extension of time because of project delays.

b. Notification of Delay. Within 30 calendar days of any Department action or omission which the Contractor believes has delayed or may delay the project, the Contractor shall notify the Resident Engineer of such a delay and indicate whether it intends to file a request for delay costs. The Contractor shall confirm such notification in writing to the Engineer within 5 calendar days of its notification to the Resident Engineer.

c. Procedures. Upon notifying the Resident Engineer, the Contractor shall keep daily records of all non-salaried labor, material and equipment expenses for all operations that are allegedly affected by the delay. The Contractor shall also identify in the daily records each operation affected by the delay and the station location of each such operation. The Department will also keep daily records. Each Monday, the Contractor shall compare the previous week's daily records with those maintained by the Department. The Contractor shall report to the Engineer within 10 calendar days of each such comparison all disagreements with Department records.

Failure to meet to review the Department's records or to report disagreements between the two sets of records will constitute the assumption that the Department's records are accurate.

Delay costs allegedly incurred prior to notifying the Resident Engineer that operations have been delayed will not be allowed.

1. Each Monday, the Contractor shall prepare and submit written reports to the Resident Engineer regarding alleged delays which contain the following information:

(a) Number of days behind schedule.

(b) Identify all operations that have been delayed, or will be delayed.

(c) Explain how the Department's act or omission delayed each operation, and estimate the amount of time required to complete the project.

(d) Itemize all extra costs being incurred, with explanations for each such cost.

2. Within 15 calendar days of the termination of an alleged delay, the Contractor shall submit a report to both the Resident Engineer and the Engineer containing the following information:

(a) A description of the operations that were delayed. Documentation and explanation of how the Department caused the delay to include the reports of all scheduling experts or other consultants, if any; and

(b) An as-built chart, or other graphic depiction of how the operations were delayed.

(c) An item-by-item calculation and explanation of extra costs being sought.

3. The Engineer will review the Contractor's submission and any reports prepared by the Resident Engineer. A written decision will be provided to the Contractor within 60 days of the receipt of the Contractor's submission. If the Engineer determines that the Department is responsible for delays to the Contractor's operations, an equitable adjustment to the Contract will be authorized in accordance with **Subsection 109.10; Compensation for Project Delays**.

105.21 WORK ZONE TRAINING. The Contractor's TMP Implementation Manager and all other Contractor/Subcontractor personnel responsible for the setup, operation, maintenance, inspection, movement and/or breakdown of temporary traffic control devices shall be trained in accordance with the Department's "Training Guidelines for Personnel Responsible for Work Zone Safety & Mobility" and shall possess a certificate of satisfactory completion of such training. Training shall be at a level appropriate to the individual's job responsibilities and to the job decisions the individual is required to make and shall be completed prior to the commencement of work.

SECTION 106

CONTROL OF MATERIAL

106.01 SOURCE OF SUPPLY AND QUALITY REQUIREMENTS. Materials used on the work shall meet all quality requirements of the Contract and the "Master Schedule for the Preparation of a Project Schedule for Sampling, Testing, and Certification of Materials. In order to expedite the inspection and testing of materials, the Contractor shall notify the Engineer of the proposed sources of materials prior to delivery. At the option of the Engineer, materials may be approved at the source of supply before delivery is started. If, after trial, it is found that sources of supply which have been approved do not produce a reasonably uniform product, or if the product from any source proves unacceptable at any time,

the Contractor shall furnish materials from other sources. All materials shall be new unless otherwise specified in the Contract.

No material which, after approval, has become unfit for use shall be employed in the work.

The Department reserves the right to retest all materials which have been previously tested and accepted at the source of supply and delivered to the site. However, prior to incorporation into the work the Department may reject all such materials which, when retested, do not reasonably meet the requirements of these Specifications, or those established for the specific project.

a. Buy American Requirements for Domestic Steel. In accordance with the U.S. Code of Federal Regulations Title 23 and Section 165 of the Surface Transportation Assistance Act of 1982, only such permanently incorporated steel materials as have been manufactured in the United States will be used on all projects. Further, any pig iron and/or pelletized and reduced iron ore, used to produce permanently incorporated steel materials or permanently incorporated non-steel products, must be manufactured in the United States.

Bidders are advised that the Contract will be awarded to the bidder who submits the lowest total bid based on furnishing domestic steel materials.

1. Certification of Steel. All manufacturing processes of the steel material in a project (i.e., smelting, and any subsequent process which alters the steel material's physical form or shape or changes its chemical composition) must occur within the United States to be considered of domestic origin. This includes processes such as rolling, extruding, machining, bending, grinding, drilling and the application of coatings, including iron.

2. Minimal Use of Foreign Steel. Section 635.410(b)(4) of Title 23 CFR permits a minimal amount of foreign steel to be incorporated into a Federal-aid project. This amount is defined as one-tenth of one percent (0.1 percent) of the total contract cost or $2,500, whichever is greater. The cost of the foreign steel is defined as its value delivered to the project.

106.02 LOCAL MATERIAL SOURCES. Possible sources of local materials may be designated on the Plans and described in the Special Provisions. In general, the quality of material in such deposits will be acceptable. However, the Contractor shall determine the amount of equipment and work required to produce a material meeting the requirements of these Specifications. The Contractor shall understand that it is not feasible to ascertain from samples the limits for an entire deposit, and that variations shall be considered as usual and are to be expected. The Engineer may order procurement of material from any portion of a deposit and may reject other portions of the deposit as unacceptable.

The Department may acquire and allow the Contractor to take materials from sources designated on the Plans and/or as specified in the Special Provisions. The Department may also allow the Contractor to use such other property as may be specified, for plant site, stockpiles and hauling roads.

If the Contractor desires to use material from sources other than those designated, the Contractor shall acquire the necessary rights to take materials from the sources and shall pay all costs related thereto, including any which may result from an increase in length of haul. All costs of exploring and developing such other sources shall be borne by the Contractor. The use of material from other than designated

sources will not be permitted until representative samples taken by the Engineer have been approved and written authority is granted for the use thereof.

When material deposits are neither described in the Special Provisions nor designated on the Plans, the Contractor shall provide sources of material acceptable to the Engineer.

When sources of material or material deposits are provided by the Contractor, the Department will assume the cost of processing samples to determine the suitability of the material.

Sites from which material has been removed shall, upon completion of the work, be left in a neat and presentable condition.

106.03 SAMPLES, TESTS, CITED SPECIFICATIONS. Materials will be inspected, tested and accepted by the Engineer before incorporation in the work. Work in which untested and unaccepted materials are used without approval of the Engineer shall be performed at the Contractor's risk. No payment will be made for materials found to be unacceptable and/or unauthorized. Unless otherwise designated, tests in accordance with the cited current standard methods of AASHTO, ASTM or other organizations used by the Department will be made by, and at the expense of the Department. Samples will be taken by a qualified representative of the Department. Materials being used are subject to inspection, test or rejection at any time prior to incorporation into the work. Copies of all tests will be furnished to the Contractor's representative upon request.

Whenever there is an AASHTO designation followed by an ASTM designation, the AASHTO designation will govern when there are minor differences between the two specifications.

106.04 CERTIFICATION OF COMPLIANCE. The Engineer may permit use, prior to sampling and testing, of certain materials or assemblies accompanied by Certificates of Compliance, stating that such materials or assemblies fully comply with the requirements of the Contract. The certificate shall be signed by the manufacturer. Each lot of such materials or assemblies delivered to the work must be accompanied by a Certificate of Compliance and clearly identified.

Materials or assemblies used on the basis of Certificates of Compliance may be sampled and tested and if found not in conformity with Contract requirements will be subject to rejection whether in place or not.

The form and distribution of Certificates of Compliance shall be as approved by the Engineer.

The Engineer is authorized to refuse permission for use of materials or assemblies on the basis of Certificates of Compliance.

Unexpired Warranties. If the Contractor is furnished a warranty at the time of purchase of any product or material and the warranty has not expired at the time of acceptance of the work by the State, the warranty shall then be turned over to the State.

106.05 PLANT INSPECTION. The Engineer may undertake the inspection of materials at the source. Manufacturing plants may be inspected for compliance with specified manufacturing methods. Material samples will be obtained for laboratory testing for compliance with materials quality requirements. This may be the basis for acceptance of manufactured lots as to quality.

a. Conditions. In the event plant inspection is undertaken the following conditions shall apply:

1. The Engineer shall have the cooperation and assistance of the Contractor and the producer with whom it has contracted for materials.

2. The Engineer shall at all times have full access to those parts of the plant where the manufacture or production of materials is taking place.

3. Adequate safety measures shall be provided and maintained.

106.06 STORAGE OF MATERIALS. Materials shall be stored to insure the preservation of their quality and fitness for the work. Stored materials, even though approved before storage, may again be inspected prior to their use in the work. Stored materials shall be located to facilitate their prompt inspection.

a. Location of Stored Materials and Equipment.

1. Roads without Curbing and Sidewalks. Construction materials and equipment may be stored within the "clear zones" designated below provided that prior written approval has been granted by the Engineer. Material stored in these clear zones must be removed within fourteen (14) calendar days. Equipment may be stored in the clear zones only during workdays; i.e., no overnight storage of equipment will be allowed.

Posted Speed	Clear Zone Distance from Edge of Travel Lane
35 mph or less	12 feet
40-45 mph	16 feet
50 mph or less	20 feet
55 mph or less	30 feet

Any area of the clear zones which is used for storage of construction material and/or equipment must be clearly delineated with appropriate traffic control devices.

Storage sites shall be restored to their original condition at the sole expense of the Contractor.

Additional space required for storage shall be provided at the Contractor's expense. Private property shall not be used for storage purposes without written permission of the owner or lessee. If requested by the Engineer, copies of such written permission shall be furnished by the Contractor.

The Contractor shall comply with all Federal, State and local statutes and/or ordinances in reference to the storage of materials, and shall be liable for all damages arising from the violation thereof.

2. Roads with Curbing and Sidewalks. No portion of the shoulders and sidewalks may be used for storage of construction equipment and/or material.

106.07 HANDLING MATERIALS. Materials shall be handled in such manner to preserve their quality and fitness for the work. Aggregates shall be transported from the storage site to the work in vehicles constructed to prevent loss or segregation of materials after loading and measuring.

106.08 UNACCEPTABLE MATERIALS. Materials not reasonably conforming to the requirements of the Specifications will be considered as unacceptable and all such materials will be rejected and removed immediately from the site of the work unless otherwise instructed by the Engineer. Rejected material, the defects of which have been corrected, shall not be used again until approval by the Engineer has been granted.

106.09 DEPARTMENT-FURNISHED MATERIAL. The Contractor shall furnish materials required to complete the work, except those specified to be furnished by the Department.

Material furnished by the Department will be delivered or made available to the Contractor at the points specified in the Contract Documents.

The cost of handling and placing Department-furnished materials after they are delivered to the Contractor shall be included in the Contract price for the item in which they are used.

The Contractor will be responsible for all material delivered. Deductions will be made from any monies due the Contractor for shortages, deficiencies, other causes, and damage which may occur after delivery. Demurrage charges, resulting from the Contractor's failure to accept the material at the designated time and point of delivery will also be deducted from monies due the Contractor.

SECTION 107

LEGAL RELATIONS AND RESPONSIBILITY TO PUBLIC

107.01 LAWS TO BE OBSERVED. The Contractor shall keep fully informed of Federal and State laws, local laws, ordinances, and regulations and orders and decrees of bodies or tribunals having any jurisdiction or authority, which in any manner affect those engaged or employed on the Project, or which affect the conduct of the Project. The Contractor shall observe and comply with all such laws, ordinances, regulations, orders, and decrees; and shall protect and indemnify the State and its representatives against any claim or liability arising from the violation of any such law, ordinance, regulation, order, or decree, whether by the Contractor, the subcontractors, suppliers of materials or services, or others engaged by the Contractor, or the employees of any of them. If any discrepancy or inconsistency is discovered between the Contract and any law, ordinance, regulation, order or decree, the Contractor shall immediately report the same to the Engineer in writing.

The Contractor shall execute and file such documents, statements and affidavits required under applicable Federal or State law or regulation affecting its Proposal, Contract or the prosecution of the work. The Contractor shall permit the examination of any records made subject to such examination by Federal or State law or by regulations promulgated thereunder by any State or Federal agency charged with the enforcement of such law.

107.02 SPECIFIC STATUTES REQUIRED TO BE INSERTED. Every contract for the construction of public works by the State, or by persons or organizations contracting with the State for such construction, shall contain the following provisions from the General Laws of Rhode Island:

a. Title 37, Chapter 13, Sections 5, 6, and 7, respectively, of the General Laws of Rhode Island, 1956, entitled "Labor and Debts of Contractors," read as follows:

> "37-13-5. PAYMENT FOR TRUCKING OR MATERIALS FURNISHED -- Withholding of sums due. -- A contractor or subcontractor on public works authorized by a proper authority shall pay any obligation or charge for trucking and material which have been furnished for the use of such contractor or subcontractor, in connection with the public works being performed by him, within ninety (90) days after such obligation or charge is incurred or the trucking services has been performed or the material has been delivered to the site of the work, whichever is later. When it is brought to the notice of the proper authority in a city or town, or the proper authority in the state having supervision of such contract, that such obligation or charge has not been paid by the contractor or subcontractor, the proper authority may deduct and hold for a period not exceeding sixty (60) days, from sums of money due to the contractor or subcontractor, the equivalent amount of such sums certified by a trucker or materialman creditor as due him, as provided in this section, and which the proper authority determines is reasonable for trucking performed or materials furnished for such public works."
>
> "37-13-6. ASCERTAINMENT OF PREVAILING RATE OF WAGES. -- Before awarding any contract for public works to be done, the proper authority shall ascertain from the director of labor the general prevailing rate of the regular, holiday and overtime wages paid and the general prevailing payments on behalf of employees only, to lawful welfare, pension, vacation, apprentice training and educational funds (payments to said funds must constitute an ordinary business expense deduction for federal income tax purposes by contractors) in the city, town, village or other appropriate political subdivision of the state in which the work is to be performed, for each craft, mechanic, teamster, laborer or type of workman needed to execute the contract for the public works, and shall specify in the call for bids for the contract and in the contract itself the general prevailing rate of the regular, holiday, and overtime wages paid and the payments on behalf of employees only, to such welfare, pension, vacation, apprentice training and education funds existing in the locality for each craft, mechanic, teamster, laborer or type of workman needed to execute the contract or work."
>
> "37-13-7. APPLICABILITY AND DETERMINATION OF PREVAILING RATE OF WAGES. -- every call for bids for:
>
> (a) every contract in excess of $1,000 to which the State of Rhode Island or any political subdivision thereof is party, for construction, alteration, and/or repair, including painting and decorating, of public buildings or public works of the State of Rhode Island or any political subdivision thereof, and which requires or involves the

employment of employees shall contain a provision stating the minimum wages to be paid various types of employees which shall be based upon the wages that will be determined by the director of labor to be prevailing for the corresponding types of employees employed on projects of a character similar to the contract work in the city, town, village, or other appropriate political subdivision of the State of Rhode Island in which the work is to be performed; and every contract shall contain a stipulation that the contractor or his subcontractor shall pay all said employees employed directly upon the site of the work, unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account, the full amounts accrued at time of payment computed at wage rates not less than those stated in the call for bids, regardless of any contractual relationships which may be alleged to exist between the contractor or subcontractor and such employees and that the scale of wages to be paid shall be posted by the contractor in a prominent and easily accessible place at the site of the work; and the further stipulation that there may be withheld from the contractor so much of accrued payments as may be considered necessary to pay to such employees employed by the contractor or any subcontractor on the work the difference between the rates of wages required by the contract to be paid said employees on the work and the rates of wages received by such employees and not refunded to the contractor, subcontractors, or their agents;

(b) the term `wages, scale of wages', `wage rates', `minimum wages', and `prevailing wages' shall include:

(1) the basic hourly rate of pay; and
(2) the amount of

(A) the rate of contribution made by a contractor or subcontractor to a trustee or to a third person pursuant to a fund, plan, or program; and

(B) the rate of costs to the contractor or subcontractor which may be reasonably anticipated in providing benefits to employees pursuant to an enforceable commitment to carry out a financially responsible plan or program which was communicated in writing to the employees affected, for medical or hospital care, pensions on retirement or death, compensation for injuries or illness resulting from occupational activity, or insurance to provide any of the foregoing, for unemployment benefits, life insurance, disability and sickness insurance, or accident insurance, for vacation and holiday pay, for defraying costs of apprenticeship or other similar programs, or for other bonafide fringe benefits, but only where the contractor or subcontractor is not required by other federal, state, or local law to provide any of such benefits: Provided, that the obligation of a contractor or subcontractor to make payment in accordance with the prevailing wage determinations of director of labor insofar as this chapter of this title and other acts incorporating this chapter of this title by reference are concerned may be discharged by the making of payments in cash, by the making of contributions of a type referred to in paragraph (2) (A), or by the assumption of an enforceable commitment to bear the costs of a plan or program of a type referred to a paragraph (2) (B), or any combination thereof, where the aggregate of any such payments, contributions, and costs is not less than the rate of pay described in paragraph (1) plus the amount referred to in paragraph (2)."

b. Title 28, Chapter 26, Section 5 of the General Laws of Rhode Island, 1956, entitled "License Required for Operation of Hoisting Machinery - Public Contracts," reads as follows:

> 28-26-5. No persons shall operate or be in direct charge of a hoisting or excavation gasoline, steam, diesel, electric or compressed air hoist, shovel, crane, excavator, of five horsepower or more without obtaining a license to do so as provided in this chapter. No user or agent of use of any such described steam, gasoline, diesel, electric or compressed air hoisting machinery shall permit it to be operated unless it is operated by a duly licensed person as hereinafter provided by this chapter.

c. Chapters 85, 86 AND 88 of the Public Laws or Rhode Island, 1960:

> Section 123 of the aforesaid chapters defines the authority of Director of Department of Public Works and use of Federal assistance and provides in part that in the event that Federal funds or Federal assistance are made available to the State for use in carrying out highway projects, said projects shall be carried out and executed in all respects subject to the provisions of the appropriate Federal law providing for the construction of such projects and the rules and regulations made pursuant thereto, and to such terms, conditions rules and regulations, not inconsistent with such Federal law, rules and regulations as said Director may establish to ensure the proper execution of said projects, therefore, any provisions of the State laws that conflict with the Federal laws, rules and regulations are not applicable to projects financed in whole or in part with Federal Aid Highway funds.

d. Public Law - Chapter 5-6-2; entitled "Work for Which License Required," reads as follows:

> No person, firm, or corporation shall enter into, engage in, or work at the business of installing wire, conduits, apparatus, fixtures and other appliances for carrying or using electricity for light, heat or other purpose, unless such person, firm or corporation shall have received a license and a certificate therefore, issued by the State Board of Examiners of Electricians.

107.03 PERMITS, LICENSES AND TAXES. The Contractor shall procure all permits (except those specifically provided in the Contract Documents) and licenses, pay all charges, fees, and taxes, and give all notices necessary and incidental to the due and lawful prosecution of the work. These costs shall be included in the unit prices bid for the various items of the Contract work.

107.04 PATENTED DEVICES, MATERIALS, AND PROCESSES. If the Contractor employs any design, device, material, or process covered by letters of patent or copyright, the Contractor shall provide for such use by suitable legal agreement with the patentee or owner. The Contractor and the Surety shall indemnify and save harmless the State, any affected third party, or political subdivision from any and all claims for infringement by reason of the use of any such patented design, device, material, process, trademark or copyright. The Contractor shall indemnify the State for costs, expenses, and damages which it may be obligated to pay by reason of any infringement thereof, during the prosecution or after the completion of the Project.

107.05 RESTORATION OF SURFACES OPENED BY PERMIT. The right to construct or reconstruct any utility service in the highway or street or to grant permits for same is expressly reserved by the Department for the proper authorities of the municipality in which the work is performed. The Contractor shall not be entitled to damages either for digging up the street or for any delay occasioned thereby, unless otherwise provided for under **Subsection 104.03; Differing Site Conditions**.

Any individual, firm, or corporation wishing to make an opening in the highway must secure a permit from the Department. The Contractor shall allow parties bearing such permits, and only those parties, to make openings in the highway. When ordered by the Engineer, the Contractor shall make all necessary repairs necessitated by such openings. Such necessary work will be paid for as either Extra Work, or as otherwise provided in these Specifications. All repair work will be subject to the same conditions as applied to original work.

107.06 FEDERAL-AID PARTICIPATION. When the United States Government participates in the cost of the work covered by the Contract, the work shall be performed under the supervision of the Department but otherwise subject to the inspection and approval of the appropriate officials of the United States Government. Such inspection shall neither make the Federal Government a party to this Contract nor interfere with the rights of either party to said Contract.

When any Federal laws, rules, or regulations are in conflict with any provisions of a Federally-assisted Contract, the Federal requirements shall prevail, take precedence, and be in force over and against any such conflicting provisions.

107.07 SANITARY, HEALTH AND SAFETY PROVISIONS. The Contractor shall observe rules and regulations of Federal,State and local health officials. The Contractor shall not require any worker to work in surroundings or under conditions which are unsanitary, hazardous or dangerous to health or safety.

The Contractor shall admit without delay and without the presentation of an inspection warrant, any inspector of the Occupational Safety and Health Administration or other legally responsible agency involved in safety and health administration upon presentation of proper credentials.

107.08 PUBLIC CONVENIENCE AND SAFETY. The Contractor shall conduct the work to assure the least possible obstruction to traffic. The safety and convenience of both the general public and the residents along and adjacent to the highway, as well as the protection of persons and property, shall be provided by the Contractor as specified under **Subsection 104.08; Maintenance of Traffic**, or as the Engineer may direct.

The Contractor shall comply with the safety provisions of all laws, rules, codes, and regulations applicable to the type of work being performed. The Engineer will suspend the work of the Contract if the Contractor fails either to comply with said safety provisions or provide adequate protection for inspection of the work by the Engineer or his/her authorized representatives.

a. Accident Reports. The Contractor shall furnish the Engineer with two copies of a report of any accident occurring on the Project that involves:

1. Personal injury requiring treatment by a physician.

2. Loss of time on the job.

3. Public liability or property damage.

Accident reports shall be submitted on forms acceptable to the Engineer.

107.09 BARRICADES AND WARNING SIGNS. The Contractor shall provide, erect, and maintain all necessary barriers, barricades, lights, danger signals, signs and other traffic control devices, and shall take all necessary precautions for the protection of the work and the safety of the public.

Highways or bridges closed to traffic shall be protected by effective barricades. Suitable warning signs and protective devices shall be provided to properly control and direct traffic.

Barricades, warning signs, lights, temporary signals, and other protective devices must conform with the Manual on Uniform Traffic Control Devices for Streets and Highways published by the U.S. Government printing office.

107.10 USE OF EXPLOSIVES. When explosives are necessary for the prosecution of the work, the Contractor shall not endanger life, property or new work. The Contractor shall be responsible for damage resulting from the use of explosives.

The Contractor shall comply with all laws and ordinances, as well as with Title 29 and Title 30 of the Code of Federal Regulations, and the Safety and Health Regulations for Construction of OSHA, whichever is the most restrictive, in the use, handling, loading, transportation, and storage of explosives and blasting agents.

a. Additional Specific Requirements. The Contractor shall comply with the following:

1. The Contractor shall be solely responsible for employing such plant, equipment and construction methods necessary to accomplish the work of this Contract with complete safety and without damage to persons, existing buildings, structures, facilities and utilities.

2. The Contractor shall furnish the services of technical representatives of the manufacturer of the explosive materials. Such individuals shall be experienced in the use of high explosives in blasting operations under the circumstances to be encountered in the work of this Contract. The Contractor shall furnish the services of the explosive manufacturer's representatives for such lengths of time prior to starting blasting operations as is necessary to determine the proper equipment, devices, materials, methods and procedures to be used for the proper performance of the work. The Contractor shall also furnish the services of the explosive manufacturer's representatives during the preparation for, and progress of blasting operations for such lengths of time and as frequently as necessary to assure that blasting operations shall be performed in a safe and proper manner.

3. Prior to commencement of work, the Contractor shall meet and confer with the Engineer at which time the Contractor shall outline in detail his proposed administration of an overall safety program, which program shall at all times be satisfactory to the Engineer. The Contractor shall furnish to the Engineer copies of the current safety program and procedures for the safety and prevention of injury to persons and the prevention of damage to property and the work. The Contractor shall comply with this program at all times during the prosecution of the work.

4. All operations involving explosives and/or blasting agents shall be in accordance with the "Suggested Code for the Manufacture, Transportation, Storage and Use of Explosives and Blasting Agents" published by the Institute of Makers of Explosives, as amended. Wherever the Code and the Rhode Island Standard Specifications conflict, the Code shall apply. The Contractor shall be responsible for developing techniques necessary to obtain the required ledge slopes consistent with maximum safety requirements.

b. Care in Blasting. It is especially required that blasting operations shall be conducted with all possible care and in such a manner as to prevent injury to persons and property. A sufficient warning shall be given to all persons in the vicinity of the work before blasting.

No blasting will be allowed within 25 feet of an existing building or in-service underground utility line.

c. Power of Explosives. The explosives employed in the work shall be of such power and placed in such quantities and positions that will not:

1. Unduly enlarge the excavation.

2. Unnecessarily shatter the rock upon or against which the work will be installed.

3. Injure work already in place.

d. Transportation, Handling, and Storage. Explosives must be carefully transported, stored, handled and used as required by applicable State and local ordinances and laws. The necessary permits for such transportation, storage, handling and use shall be obtained by the Contractor. The Contractor shall show such permits to the Engineer before any blasting will be allowed. The Contractor shall keep on the job only such quantity of explosives as may be needed for the work underway and only during such time as they are being used. Explosives shall be stored in a secure manner and separately from all tools. Caps or detonators shall be stored separately and at a point over 100 feet distant from the explosives. When the need for explosives is ended, all such material remaining on the job shall be promptly removed from the premises.

e. Approval of the Engineer. The approval of the Engineer shall first be obtained before blasting is permitted. If, in the opinion of the Engineer, blasting is unsafe or dangerous to persons, or to existing structures and utilities, the Contractor shall employ pneumatic tools, drilling and splitting mechanically, or by hand, or by other such means that do not require the use of explosives for the removal of rock, boulders, or ledge, all at no additional expense to the State.

f. Notification of Local Authorities. Before any dynamite or detonator caps are stored or used under this Contract, the Contractor shall contact the Police and Fire Departments of the city or town in which the project is located for instructions relative to the regulations for possession and use of explosives in that community. The Contractor shall obtain all required permits or licenses for possession and use of explosives on the site or sites of construction under this Contract. In addition, the Contractor shall be responsible:

1. For designating an individual who shall be responsible for the explosive materials at all times.

2. For the immediate reporting to the Police Department of the Cities or Towns in which the project is located of all unaccounted for explosive materials.

g. Records. The Contractor shall keep a complete record of blasting operations, noting the date, exact location with reference to a datum, weight of charge, and whether the firing was instantaneous or delayed. The Contractor shall furnish the Engineer with a complete record of operations during the preceding weekly period.

1. Records shall indicate by date the quantity and type of explosive materials delivered to the construction sites(s); the quantity of explosive material used; and the quantity of such material subsequently removed from the construction site(s).

2. All records related to the possession and use of explosive materials shall be open for inspection by the Engineer and the Police Departments of the cities and towns in which the project is located.

3. The Contract prices for the various items of work shall include full compensation for providing a complete record of blasting operations.

h. Repairs. The Contractor is cautioned that it will be responsible for any damage to existing roadway surfaces, drainage lines, structures or other objects as a result of blasting operations. The Contractor will be required to repair such damage as may be directed by the Engineer in accordance with prevailing Rhode Island Special Provisions or Standards for the particular type of work involved. The Contractor shall assume the full cost of making such repairs.

107.11 PROTECTION AND RESTORATION OF PROPERTY AND LANDSCAPE. The Contractor shall be responsible for the preservation of all public and private property and shall protect carefully from disturbance or damage all land monuments and property marks until the Engineer has witnessed or otherwise referenced their location. The Contractor shall not move such monuments and marks until so directed.

When the Contractor's operations encounter remains of prehistoric dwelling sites or artifacts of historical or archaeological significance, the operations shall be temporarily discontinued. The Engineer will contact archaeological authorities to determine the disposition thereof. When directed by the Engineer, the Contractor shall excavate the site to preserve the artifacts and shall remove and deliver them to the custody of the proper state authorities. Such excavation will be paid for as hereinafter provided in **Subsection 109.04; Differing Site Conditions, Changes, Extra Work, and Force Account Work**.

The Contractor shall be responsible for all damage or injury to public or private property resulting from any act, omission, neglect, or misconduct in, of either the Contractor's or its subcontractors' manner or method of executing the work, or in consequence of the non-execution thereof. Furthermore, the Contractor shall be responsible for all such damage due to defective materials. The Contractor shall restore, at its own expense, such property to a condition similar or equal to that existing before such damage or injury was done, by repairing, rebuilding, or otherwise restoring as directed by the Engineer.

Should the Contractor enter into, either directly or indirectly, an agreement with a property owner within the project limits, the Contractor must first obtain the signature of the property owner on the so-called LETTER TO THE PROPERTY OWNER to be provided by the Department. This document explains that the State is not a party to the agreement between the Contractor and the property owner and must be signed by the property owner and returned to the Resident Engineer. If the agreement affects or changes the design of the roadway, the Contractor must first submit these modifications, via shop drawings, to the Chief Engineer for approval.

107.12 FOREST PROTECTION. In carrying out work within or adjacent to State or National Forests, the Contractor shall comply with all regulations of the State Fire Marshall, Conservation Commission, Forestry Department, or other authority having jurisdiction governing both the protection of forests and the prosecution of work within such forests. The Contractor shall observe all sanitary laws and regulations with respect to the performance of work within or adjacent to such forest areas. The Contractor shall maintain the areas in an orderly condition, dispose of all refuse, obtain permits for the construction and maintenance of all construction camps, stores, warehouses, residences, latrines, cesspools, septic tanks, and other structures in accordance with the requirements of the Forest Supervisor.

The Contractor shall take all reasonable precaution to prevent and suppress forest fires. Furthermore, the Contractor shall require its employees and subcontractors, both independently and at the request of forest officials, to do all reasonably within their power to prevent and suppress and to assist in preventing and suppressing forest fires and to make every possible effort to notify a forest official at the earliest possible moment of the location and extent of any fire observed by them.

107.13 RESPONSIBILITY FOR DAMAGE CLAIMS.

a. Indemnification. The Contractor shall defend, indemnify and hold harmless the State, the Department, its officers and employees, from any and all suits, actions, claims, losses, expenses, damages and any and all other liabilities of any character resulting in any injuries or damage to any person, entities, or property arising out of (or which may be claimed to arise out of) any act and/or omission of the Contractor or its subcontractors, in performance of work covered by the Contract, and/or in consequence of any neglect in safeguarding the work; and/or through use of unacceptable materials in constructing the work; and/or because of any neglect, or misconduct of the Contractor; and/or because of any claims or amounts recovered from any infringements of patent, trademark, or copyright; and/or from any claims or amounts arising out of or recovered under the Workers' Compensation Act, or any other law, ordinance, order, or decree. The State may retain for its exclusive use, without recourse by the Contractor or anyone claiming under the Contractor, any and all amounts due the Contractor as provided under the Contract Documents to assure the Contractor's compliance with this Section. In the event no money is due or the retained sums are insufficient to fully indemnify the State hereunder, the Surety shall

be held liable with the Contractor until this Section is complied with in full; except that money due the Contractor will not be withheld when satisfactory evidence is produced that the Contractor is adequately protected by public liability and property damage insurance, the insurer has been given proper, timely notice of any claims arising from the work performed by the Contractor pursuant to the Contract, and the insurer has assumed defense of the claim. The Contractor shall provide written confirmation satisfactory to the Department that all such actions have been properly addressed prior to final payment under **Subsection 109.09**. Notwithstanding the foregoing, nothing herein contained shall be deemed to constitute a waiver of the sovereign immunity of the State, which immunity is hereby reserved by the State.

b. Liability Insurance. The Contractor shall procure and maintain at the Contractor's own expense, until final acceptance of Contract, insurance coverage for damages assumed by Contract or imposed by law, of the kinds and in the amounts specified, with insurance companies authorized to do business in the State. The insurance shall cover all operations performed under the Contract, whether by the Contractor or by subcontractors. Before commencing the work, the Contractor shall furnish certificates of insurance in the form satisfactory to the Department certifying that the policies will not be changed or canceled until 30-days written notice has been given to the Department. The types and limits of insurance are as follows:

1. Workers' Compensation Insurance. Coverage shall be in accordance with prevailing laws.

2. Liability and Property Damage Insurance. Each policy shall name the Department as an additional insured and shall include a provision requiring the insurer to investigate and defend the Department against any and all claims for death, bodily injury or property damages even if groundless. Coverages shall be in the following amounts:

(a) Bodily injury liability:

$500,000, each person.
$1,000,000, each occurrence.

(b) Property damage liability:

$500,000, each occurrence.
$1,000,000, aggregate.

c. Insurance Covering Special Hazards. Special hazards shall be covered by either riders to the liability and/or property damage policy or policies hereinabove specified, or by separate policies of insurance as follows:

1. Property Damage Liability arising out of the collapse of or structural injury to any building or structure due to:

(a) excavation (including borrowing, filling, or backfilling in connection therewith), tunneling, pile driving, cofferdam work or caisson work; or

(b) moving, shoring, underpinning, raising or demolition of any building or structure, or removal or rebuilding of any structural support thereof.

2. Property Damage Liability for injury to or destruction of property arising, directly or indirectly from blasting or explosions however caused, other than explosions of air or steam vessels, piping under pressure, prime movers, machinery or power transmitting equipment.

107.14 THIRD PARTY BENEFICIARY CLAUSE. It is specifically agreed between the parties executing this Contract that it is not intended by the provisions of the Contract to create the public or any member thereof a third party beneficiary hereunder, or to authorize anyone not a party to the Contract to maintain a suit for personal injuries or property damage pursuant to the provisions of the Contract.

107.15 PERSONAL LIABILITY OF DEPARTMENT EMPLOYEES. The Director, Engineer, RIDOT employees or their authorized representatives are acting solely as agents and representatives of the Department when carrying out and exercising the power or authority granted to them under the Contract.

107.16 NO WAIVER OF LEGAL RIGHTS. Upon completion of the Contract, the Department will expeditiously make final inspection and notify the Contractor of acceptance. Final acceptance, however, shall neither preclude the Department from correcting any measurement, estimate, or certificate made before or after completion of the Contract, nor prevent the Department from recovering from the Contractor or Surety or both, overpayments sustained by failure on the part of the Contractor to fulfill the obligations under the Contract. A waiver on the part of the Department of any breach of any part of the Contract shall not be held to be a waiver of any other or subsequent breach.

The Contractor, without prejudice to the terms of the Contract, shall be liable to the Department for latent defects, fraud, or such gross mistakes as may amount to fraud, or as regards the Department's rights under any warranty or guaranty.

107.17 HAZARDOUS MATERIAL. If the Contractor encounters or exposes during construction any abnormal condition which indicates the presence of a hazardous material or toxic waste, it shall immediately suspend work in the area and notify the Engineer. The Contractor's operation in this area shall not resume until so directed by the Engineer; however, the Contractor shall continue working in other areas of the project, unless otherwise directed by the Engineer.

Abnormal conditions shall include, but shall not be limited to, the following: presence of barrels; obnoxious odors; excessively hot earth; smoke; or any other condition which could be a possible indicator of hazardous material or toxic waste. The conditions shall be treated with extreme caution.

Disposition of the hazardous material or toxic waste shall be made in accordance with the requirements and regulations of the Rhode Island Department of Environmental Management. Where the Contractor performs necessary work required to dispose of these materials, the work will be performed under a supplemental agreement. Should the disposition of waste material require special procedures by

certified personnel, the Department will make arrangements with qualified persons to dispose of the material.

107.18 CIVIL RIGHTS. The Contractor shall comply with Federal, State and local laws, rules and regulations which set forth unlawful employment practices including that of discrimination because of race, religion, color, sex or national origin, and which define actions required for Affirmative Action and Minority (Disadvantaged) Business programs.

SECTION 108

PROSECUTION AND PROGRESS

108.01 SUBLETTING OF CONTRACT. The Contractor shall not sublet, sell, transfer, assign, or otherwise dispose of the Contract or contracts or any portion thereof, or of its right, title, or interest therein, without written consent of the Engineer. If such consent is given, the Contractor will only be permitted to sublet a portion thereof. The Contractor will be required to perform with its own organization, work amounting to not less than 40 percent of the adjusted contract cost. The adjusted contract cost is the total contract cost less the total cost of subcontract specialty items listed in the Proposal. Specialty Items are defined in **Subsection 101.63**.

No subcontracts or transfers of Contract shall relieve the Contractor of liability under the Contract and Bonds. A copy of written agreements with subcontractors must be submitted when making application to sublet any work under the Contract. Furthermore, no agreements between the Contractor and its subcontractors or vendors shall create any "third party" relationships between said subcontractors or vendors and the State.

The Contractor shall provide written notice to, and obtain prior written consent from the Engineer, before allowing any subcontractor to sublet any portion of its work to a lower-tier contractor.

108.02 NOTICE TO PROCEED. The "Notice to Proceed" will stipulate the date the Contractor is expected to begin the construction and from which date contract time will be charged. Commencement of work by the Contractor constitutes a waiver of this notice.

108.03 PROSECUTION AND PROGRESS.

a. General Requirements.

1. Project Schedule Program

All construction Projects require an integrated schedule management and controls program that the Contractor shall comply with through completion. A Critical Path Method (CPM) Schedule must be developed and maintained for all Projects. The Contractor shall be required to participate in Schedule Development meetings facilitating knowledge-sharing and updating of Schedules. An integrated stepped Schedule Development process will begin once the Apparent Low Bidder letter is sent to the Contractor.

The level of detail and Schedule Submission requirements will be based on the Schedule Level A, B, or C, which shall be defined in the Special Provisions of the Contract Documents.

- Schedule Level A Projects with a high level of complexity, impact to the motoring public or community, and/or larger size Projects.

- Schedule Level B Projects of average to moderate complexity, moderate impact to the motoring public or community, and/or average size.

- Schedule Level C Smaller projects with minimal to no complexity, and minimal impact to the community. Typical examples would be resurfacing, maintenance, and landscaping projects.

The CPM Schedule shall be the Contractor's primary tool to organize and communicate their plan for the timely completion of the Project. The Schedule will be used to assess progress, delays, projection of time required, Contractor and RIDOT resources requirements, and any mitigation if necessary. The Schedule shall include all the work to be performed/required by the Primary Contractor, Subcontractors, equipment vendors, suppliers, Utility Companies, regulatory agencies, owner review and other work that is interrelated to the Contractor's work. The CPM Schedule shall accurately portray the work planned and executed and shall reflect coordination of work.

The following Schedule Submittals are required for all Projects:

(A.) PRELIMINARY PROJECT SCHEDULE
(B.) BASELINE PROJECT SCHEDULE
(C.) STATUS SCHEDULE UPDATES

Recovery Schedules will be required if requested by RIDOT.

The Project Schedules shall be used by the Engineer and Contractor for the following purposes as well as those stated in these Specifications:

- To identify the Critical Path and its specific activities.

- To identify any changes in proposed work that differs from the Specifications or the Plans (i.e., alternate phasing, Value Engineering Proposals).

- To document the actual progress of work and evaluate the time impact of changes in the work.

- Allow the Department the opportunity to mitigate the impact of unforeseen events.

- To enable the Engineer to track and prioritize the review of Shop Drawings and Submittals. To evaluate resource requirements of the Contractor and the Engineer (Level A).

- To coordinate the work of 3rd party contractors into the sequencing of the Contractor's work where necessary.

Having a timely Schedule/Schedule Update affects the Engineer's decision making. The Department shall not be liable for delays to the Contractor's work when the Contractor has failed to provide a Schedule Update in accordance with the requirements of the Contract Documents. Progress

payments may be withheld if the Contractor fails to submit required Schedule Submissions. This includes, but is not limited to Schedule Development, Schedule Updates, and Recovery Schedule Submissions.

Additional Requirements for Schedule Level A

The Contractor shall retain a scheduler(s) dedicated to the Project, with a minimum of three (3) years experience on Projects similar in size and scope. The scheduler shall be responsible for developing, updating, and maintaining the Schedule. The Contractor shall submit the resume of the proposed scheduler(s) to the Engineer for acceptance within 3 days of receiving the "Apparent Low Bidder" Letter. Determination of the scheduler(s) acceptability is made at the discretion of the Engineer. The scheduler shall be present at all required meetings, including but not limited to the Schedule Development, Schedule Update, and any other meetings which may affect the Project's Schedule.

2. Software

The software used to generate the CPM Schedule shall be capable of producing schedules in accordance with the requirements of the Contract Documents and fully compatible with software utilized by the Engineer: currently Primavera Project Planner (P3). The Contractor shall purchase and maintain a valid software maintenance agreement for each license of software necessary to produce and maintain the Project Schedules. Unless specified elsewhere in the Contract Documents, the Contractor shall comply with the terminology defined by the Primavera Project Management Manual.

b. Schedule Development.

1. Schedule Development Submittals

The scheduling requirements and Submittals will be based on the defined schedule level. The Schedule Development Process will commence on the date that the Apparent Low Bidder letter is mailed to the Contractor, which will be considered Day 1 for all Scheduling Submittals. The table below details the required Submissions and their corresponding Submission due dates for each schedule level.

STEP	STEP DESCRIPTION	SCHEDULE LEVEL			ENGINEER REVIEW DEADLINE (After receipt of submission)
		A	B	C	
Step 1	Scheduler's Resume	Day 3		-	3 days
Step 2	Initial Schedule Framework	Day 7	-	-	4 days
Step 3	Complete Schedule Framework	Day 14	Day 14	-	5 days
Step 4	Preliminary Schedule	Day 28	Day 28	Day 28	7 days
Step 5	Baseline Schedule	Day 42	Day 42	Day 42	7 days
Step 6	Bid Item Loaded Baseline Schedule	*Day 70	*Day 70	*Day 70	7 days
Step 7	Resource Loaded Schedule	Day 84	-	-	7 days
Step 8	Finalized Baseline	Day 98	Day 98	Day 98	7 days
*Required by Day 70 but no earlier than 10 Days after NTP		***All days are calendar days***			

Refer to Section D for Technical Scheduling Requirements; refer to the Special Provisions for project specific information, including Project Groups, ID Standards, Milestones and Activity Data.

The requirements for each Schedule Development Submission are listed below. Meetings will be held on a weekly basis, or as necessary, to facilitate the schedule development. Each Submission shall incorporate the accepted components, and address the comments from the previous Submission(s). If any Schedule Development Step Submission does not conform to Specification and is therefore Unacceptable, the Contractor shall revise and resubmit this for acceptance prior to proceeding to the next step. Each Submission shall include three (3) paper and (2) two electronic files (in their corresponding format).

Step 1: Scheduler's Resume

Step 2: Initial Schedule Framework Submittal:

a) Work Breakdown Structure (WBS)
b) Activity Codes: All Contractor defined activity code values.
c) Calendars: All Contractor defined calendars
d) Contractor's Submittal List (including all required Contractor Submittals)
e) Potential Value Engineering or alternate sequencing/methods.

Step 3: Complete Schedule Framework Submittal:

a) All requirements of Step 2 with prior comments addressed.
b) Activity Data for all Milestones, Submittals, Procurement and Work by Others. Data includes (1) Activity ID, (2) WBS ID, (3) Responsibility Code, (4) Activity Type, and (5) Calendar IDs.
c) Resource Definitions (Levels A Only): labor resources, work types, and equipment resources detailed by crews, incorporating all Engineer comments to date.

Step 4: Preliminary Schedule Submittal:

a) All requirements of Step 3 with prior comments addressed.
b) Activity Data, including all logic, for all work required to be performed within the first 120 days after the NTP.
c) All work after the first 120 days from NTP shall be shown in summary activities (summary activities shall not have durations greater than 30 days).
d) Narrative explaining the sequence of the work and all critical Submittals and activities.

Step 5: Baseline Schedule Submittal:

a) All requirements of Step 4 with prior comments addressed.
b) Completed Schedule showing all work activities and logic for the complete Contract.
c) Narrative Report.

Step 6: Bid Item Loaded Schedule Submittal:

a) All requirements of Step 5 with prior comments addressed.
b) Complete Bid Item Loaded Schedule.
c) Schedule Narrative which shall explain the use of resources and an explanation of all logic changes since the Baseline Schedule Submittal.

Step 7: Resource Loaded Schedule Submittal (Level A Only):

a) All requirements of Step 6 with prior comments addressed.
b) Resource loading completed for all activities in the Schedule for the entire Project

c) Schedule Narrative which shall explain the use of resources and an explanation of all logic changes made since the Baseline Schedule Submittal.

Step 8: Finalized Baseline Schedule Submittal:

The Contractor shall revise the original Baseline Schedule Submittal until the Schedule conforms to the Plans and Specifications. No additional changes shall be made. The revised Baseline Schedule Submittal shall be revised and resubmitted until accepted by the Engineer.

2. Review and Acceptance of Project Schedule Submittals

The Engineer shall review Schedule Submittals for conformance with the requirements of the Contract Documents. The planning, scheduling, and execution of the work and the accuracy of any Project Schedule shall remain the responsibility of the Contractor. The Contractor is also responsible for errors in any previously accepted Project Schedule, including but not limited to activity durations, relationships between activities, resource allocation, or any float suppression techniques.

Schedules that do not accurately reflect the work may be identified at any time. Once identified, they shall be addressed by the Contractor at no additional cost to the State. The acceptance of any Project Schedule by the Engineer does not constitute acceptance or approval of any change to the requirements of the Contract Documents including but not limited to any mandated construction sequences. Such acceptance shall not relieve the Contractor of any responsibility under the Contract for the successful completion of the work.

c. Project Schedule Updates.

Schedule Update Meetings shall be held every two weeks from Notice to Proceed to the completion of the Project. The Contractor shall be required to attend each meeting with all their update information (data as of the data date) compiled in advance. The Contractor shall have a complete and accurate report of the current progress and depiction of how future work plans shall meet the contract completion dates. Failure to attend meetings or submit Schedule Updates may result in Progress Payments being withheld. The Contractor shall provide a sufficient number of copies of the Updated Schedules at the meetings. The format of this update form shall be provided by the Engineer at the Schedule Development Meeting.

Schedule Update Submittals shall be submitted to the Engineer every two weeks on the scheduled meeting dates or no later than two (2) working days after the Project Schedule Update Meeting. If a meeting is not held, Updates shall still be submitted. The Engineer's review period for the Schedule Update Submittal is five (5) working days. Three copies of the Schedule Updates shall be submitted to the Engineer with the following components:

1. A Schedule Narrative detailing the current Milestone Status, Critical Path, and all changes made to the Schedule, including Actual Dates, Calendar and Duration changes, and logic revisions as defined in section E-3, of this specification.

2. Activity Column/Bar Chart Diagram utilizing the layouts provided by the Department at the first Schedule development meeting. This will highlight the past period progress and be utilized for the Update information.

3. Copies of the current RFI and Submittal Logs.

4. Any other documents and/or reports requested by the Engineer.

5. Computer Disk(s) with record schedule incorporating all submitted Schedule Update Data (UXXX).

All Schedule data, logic or duration changes, or any modifications to the Schedule shall be addressed and discussed with the Engineer at the Project Schedule Update Meeting. This shall be done prior to the Contractor submitting their final Schedule Updates.

Changes to the accepted Baseline Schedule shall be detailed in the Schedule Update Narrative. The acceptance and inclusion of these changes shall not be the sole basis of acceptance or entitlement to any time extension(s) or cost(s).

Schedule Update Submittals shall never be used as the sole basis for any adjustment in the Contract Time(s), regardless of any acceptance or approval by the Engineer. Any acceptance or approval of the Schedule Update Submittal by the Engineer, either expressed or implied, shall only apply to the issue of progress and not to any issue of acceptability or accuracy of the Schedule Update Submittal for use as a basis for measuring adjustments in Contract Time(s).

d. Technical Schedule Requirements.

For the purpose of enabling both the Engineer and the Contractor to readily evaluate CPM Schedules, including derived data and reports, the Schedules shall be developed and maintained in accordance with the following requirements. The Contractor will have access to templates of these requirements during Schedule Development.

All CPM Schedules shall utilize a Work-Breakdown Structure (WBS) which shall be developed by the Contractor, during Schedule Development. The following is the basic dictionary for the WBS which may be appended, with Engineer's acceptance, when further detail is required. Title Case shall be utilized in the development of the WBS descriptions. The WBS will be the primary code for displaying and organizing the graphical output schedules utilized for the project, unless otherwise directed by the Engineer.

1. Basic Structure for WBS:

XX.00 Contract Name
XX.10 Milestones
XX.15 Summary Activities
XX.30 Procurement/Shop Drawings
XX.40 Utility/RR & Work by Others
XX.60 Construction

XX are contract specific, alpha-numeric characters that will be defined by the Engineer.

2. Project Naming Standards:

Preliminary Project Schedule: PS00
Baseline Schedule: BL00
Bi-Weekly Status Schedules: Uxxx
Recovery Schedule: Rxxx

3. Project Milestones.

The Contractor shall include Milestones as specified in the Special Provisions of the Contract Documents. Late Finish Constraints shall be assigned to the Milestones where applicable.

4. Activity ID.

The Activity IDs shall be coded in accordance with the following convention:

XX	_ _ _ _	_ _ _ _
Project Specific	WBS Code	Contractor Specific
(Alpha-numeric)	(Levels 2-5)	(Alpha-numeric)

Example:	XX	1000	1000
	Project Specific	WBS Code	Contractor Specific
	(Alpha-numeric)	(Levels 2-5)	(Alpha-numeric)

Example: XX10001000

The first two characters shall be contract specific, provided by the Engineer: "XX"

Next characters: WBS codes levels 2 through 5 (two to six digits) assigned to the activity, without the decimal points.

Last two characters: unique alpha numeric characters as designated by the Contractor.

All 10 characters shall be used in the activity ID.

5. Activity Codes.

The CPM Schedules shall contain activity code classifications and code values. The Contractor shall propose a coding structure for the Engineer's review and acceptance. The activity code structure combined with the activity identification number shall provide the capability to organize information by location, road or ramp, structure, work type, Subcontractor, discipline, etc., as deemed necessary by the Engineer. The Contractor shall reserve three (3) code classifications (fields) and a minimum of six (6) characters for the Engineer's use.

RESP code will be utilized for identification of responsible party. RESP values shall be discussed at the Schedule Development Meetings.

6. Activity Descriptions.

Each activity description shall have a narrative description consisting of verb or work function (i.e. form, pour, excavate, etc.,), object (i.e. slab, footing, wall, etc.), and location (i.e. STA, bridge, pier, or retaining wall number, street, ramp, etc.,). There shall be no two activities with the same activity description. For example, an acceptable description would be, “Pour Footing Ramp Rt –Sta. 42+00 to 42+50”. The word(s) “Miscellaneous” or “Misc” or other non-specific terminology shall not be used in the activity’s description. Any abbreviations used in the activity descriptions shall be consistent with the abbreviations used throughout the Contract Documents, and should be listed therein. The formatting of the activity description in the software shall be left-justified and capitalized.

7. Activity Durations.

The CPM Schedule shall have a minimal number of activities with durations less than two (2) (a short duration) and more than twelve (12) (a long duration) working days. The Contractor may request permission from the Engineer to assign durations greater than twelve (12) working days. If the Engineer accepts the Contractor's request to use a long duration, the reason for the request shall be detailed in the Preliminary and Baseline Schedule Narratives.

8. Activity Type.

The following types of activities are required for use in the Schedule:

(a) Milestone Activities – Only Milestones that are defined in the Contract's Special Provisions shall utilize these activity types.

(b) Summary (Hammock) Schedule Activities –The Contractor shall maintain a summary schedule of hammock activities. These schedule activities must remain in all of the Schedule Submittals. The Hammock's predecessors and successors may be modified to include all those activities that are entered into the Schedule and considered part of the respective hammock activity's scope of work.

(c) Task Activities – This is the primary activity type. All activities other than Milestone and Summary as defined above shall be task activities.

9. Activity Dates.

Activity Early and Late Start and Finish dates shall be calculated for each activity based upon the schedule data date, actual dates, schedule logic, schedule constraints, calendars, and original duration or remaining duration in accordance with the scheduling parameters defined in this section. Actual dates shall be agreed upon by the Engineer.

10. Cash Flow/Activity Bid Item Loading.

The Contractor shall allocate the quantity for all bid items listed in the proposal pages. Each bid item will be associated with the corresponding schedule activity(ies). Each bid item shall be allocated to an activity or distributed to a group of activities. This shall be done through the use of Primavera's resources dictionary and resource assignment. The summed value of that portion of the activities allocated to each bid item shall equal the total value of the corresponding bid item. The bid item loading will identify the quantity of the bid item(s) associated with each schedule activity. The result of this Bid Item Loading will be an accurate portrayal of the owner's cash flow requirements for the project.

11. Calendars.

The following calendars shall be used in the Contractor's Schedule. The Contractor may request permission from the Engineer to create additional calendars, however, use of these calendars is by Engineer's acceptance. Additionally, the Contractor may not schedule work during the winter shutdown period unless the Contract specifically states that work will be performed at this time or it is later agreed to and documented. It is the responsibility of the Contractor to schedule their work during the time allotted in the Contract. The following calendars are:

Calendar 1- 5-day workweek (includes Holidays and Winter Shut Down)
Calendar 2- Procurement
Calendar 3- 6-day workweek (includes Holidays and Winter Shut Down)
Calendar 4- 7-day workweek (includes Holidays and Winter Shut Down)

Calendar 5- 5-day workweek (includes Holidays and No Winter Shut Down)
Calendar 6- 6-day workweek (includes Holidays and No Winter Shut Down)
Calendar 7- 7-day workweek (includes Holidays and No Winter Shut Down)
Calendar 8- Interstate 5-day workweek (includes Holidays & Winter Shut Down)
Calendar 9- Interstate 6-day workweek (includes Holidays & Winter Shut Down)
Calendar A - Seeding
Calendar B - Wetland Seeding
Calendar C- Plants B&B

12. Data Date.

The following are the definitions of the data dates for the CPM Schedules:
Preliminary CPM Schedule –Date of Bid Opening
Baseline CPM Schedule –Date of Bid Opening
Status Update Schedules –TBD at Schedule Development Meeting

13. Logic.

The logic in the Schedules shall represent the progression of time and the sequence of work performed within the contract time. The CPM Schedules shall conform to the following requirements:

Every activity shall have logically assigned predecessors and successors. Unless otherwise specified, the activity "Bid Opening" shall be the only activity without a predecessor, "Contract Completion" and each Contract Milestone shall be the only activities without successors.

The use of activity constraints is limited to the use of Start-No-Earlier-Than and Finish-No-Later-Than, for access restraints and Completion Milestone(s). The Contractor may request permission from the Engineer to use these constraints for other activities but acceptance is required for incorporation in the CPM Schedule. The use of Zero Free Float, Start On, Expected Finish, Mandatory Start or Mandatory Finish is strictly prohibited.

Activity lag durations shall not have a negative value unless the Contractor can convince the Engineer that it best represents realistic conditions. Activity lags shall not be used in lieu of logic relationships.

Redundant ties to preceding activities in a sequential series of activities will not be permitted. For example:

- Activity C is a successor in a Finish-Start relationship to B
- Activity B is a successor in a Finish-Start relationship to A
- Activity shall not have redundant Finish-Start relations to C

A tie representing a different constraint will not be considered redundant. For example, a logic tie showing the completion of the work scope of a predecessor is required before the successor can start is different from a logic tie representing a resource limitation and will not be considered redundant.

The Critical Path for a project shall be defined as the longest continuous series of activities progressing toward a Contractual Milestone or Contract Completion.

Out-of-sequence logic shall not be permitted to be included in a submitted CPM Schedule. The Contractor is responsible for identifying, correcting, and updating any out-of-sequence logic in a Schedule.

Float is not for the exclusive use or benefit of either the Engineer or the Contractor. It is an expiring resource available to all parties, acting in good faith, as needed to meet any Contract Milestone(s).

14. Schedule Layout Requirements.

The Engineer will provide the Contractor with the required layouts for the Schedule.

15. Schedule Calculations.

Performing scheduling calculations requires the following settings:

- Turn off automatic scheduling and leveling.
- When scheduling activities, apply retained logic.
- Calculate the start-to-start lag from early start.
- Schedule durations as: contiguous.
- Show open ends as: non-critical.
- Calculate total float as: finish float.
- Summary calculations shall use Calendar No. 1 and the weighting factor for determining percent complete shall be duration.
- Set the auto-inserting option on automatic with a minimum increment of three (3).
- Initially set critical activities using defined critical as: total float less than one (1). This option may be changed at the direction of the Engineer.
- Set language for output as: U.S. English.

16. Submittals and Procurement.

All Submittals and Shop Drawings will be represented in the Contractor's Submittal List (CSL) and shall be cross referenced in the Project Schedule utilizing the Item Codes from the Specifications. At a minimum, each submittal in the CSL will have a corresponding submittal preparation activity in the Schedule. Each submittal activity will have corresponding review and approval activity. Each submittal item will also have a corresponding procurement activity identifying the duration for the procurement of the corresponding materials, equipment, etc. The accuracy and completeness will be the responsibility of the Contractor. The Contractor is responsible for any delays due to inaccuracies in identifying Shop Drawings, Submittals, and Procurement Requirements.

e. Schedule Submission Narratives.

1. Preliminary Schedule Narrative.

The Preliminary Schedule Narrative shall contain the following information:

(a.) Identification of the data date and schedule file name.

(b.) A description of the planned flow of work, identifying all key or driving activities/resources for the first 120 days in detail and remaining project in summary. Summary activities shall not be greater than 30 calendar days in duration.

(c.) Identify any alternates or substitutions.

(d.) Response to all the owner's comments. The identification and explanation of all changes made to the schedule submission.

Additional Requirements for Schedule Level A

(e.) A summary of planned labor utilization for the Project for the first 120 days in detail. This shall identify the average and maximum number of workers by craft designation on site each month based on the resource loaded Project Schedules and the shifts to be worked. Identify actual and potential labor resource limitations.

(f.) A summary of planned equipment utilization for the Contract for the first 120 days in detail, identifying each type of operated equipment to be used in the work, the planned quantity of each type of operated equipment utilized each month, and the criteria for mobilizing and demobilizing each piece of equipment to and from the site. Identify actual and potential labor resource limitations.

(g.) Key constraints and potential problems affecting the Contractor's work must be identified: construction interfaces with existing plant operations, third parties at the project site, temporary contractor plants, facilities or fixed equipment planned for use whether within the contract ROW, contract easement, or off-site. Include length of time the plant is to be used, any planned moves, and any potential conflicts that could arise if the plan is not followed.

2. Baseline Schedule Narrative.

The Baseline Schedule Narrative shall contain the following information:

(a.) Identification of the data date and schedule file name.

(b.) A description of the planned flow of work identifying all key or driving resources.

(c.) Identify any alternates or substitutions.

(d.) Response to all of the owner's comments and the identification and explanation of all changes made to the schedule submission.

(e.) An explanation of how adverse weather has been addressed in the Baseline Schedule. Identify any and all activities that contain contingency days for adverse weather. Lack of preparation for normal adverse weather is unacceptable.

Additional Requirements for Schedule Level A

(f.) A summary of planned labor utilization for the Project identifying the average and maximum number of workers by craft designation on site each month based on the resource loaded Project Schedules and the shifts to be worked.

(g.) Identify actual and potential labor resource limitations.

(h.) Key constraints and potential problems affecting the Contractor's work must be identified: construction interfaces with existing plant operations, third parties at the project site, temporary Contractor plants, facilities or fixed equipment planned for use whether within the contract ROW, contract easement, or off-site. Include length of time the plant is to be used, any planned moves, and any potential conflicts that could arise if the plan is not followed.

3. Schedule Update Narrative.

The Schedule Update Narrative shall contain the following information:

(a.) Identification of the Update Period, the data date, and the schedule file name.

(b.) Narrative of work accomplished in the past two weeks and work planned for the next two weeks. Identify what planned work was not accomplished and why.

(c.) Narrative of the current critical path to each contractual completion Milestone.

(d.) Identify any alternates or substitutions.

(e.) Response to all of the owner’s comments, and the identification and explanation of all changes made to the Schedule Submission.

(f.) Elective Change: An elective change is defined as a revision to logic or duration(s) by the Contractor to effectively use labor and resources which have no adverse effect on the owner or Contract. The Engineer may use this as a request to a change in the Schedule. Mutual agreement on the change must be attained to implement either request. The Elective Change Narrative shall contain the following information:

(1.) Identification of the activities changed.

(2.) A description of the scope of the elective change and identification of the advantages and disadvantages of implementing the change. Identify all driving resources, if any. Identify key constraints influencing the Contractor's approach to the work.

Additional Requirements for Schedule Level A

(g.) Identification of activities with critical or near critical float (within ten (10) Working Days of the Critical Path) that were planned to occur during the Update Period, but did not occur or occurred later than the scheduled late start or late finish date, and an explanation of these delays. Identification of delays to activities taking place off the project site, e.g., Submittal preparation, fabrication, and delivery activities.

(h.) Provide a listing of all activities which have surpassed their planned duration by more than twenty (20) percent and any justification for maintaining original planned durations for future activities of like work.

(i.) A summary of any changed plans for labor utilization for the Project, identifying the average and maximum number of workers on site each month. Identify actual and potential labor resource limitations. A summary of the actual labor utilization used over the past month.

(j.) A summary of any changed plans for equipment utilization for the project, identifying each type of operated equipment to be used on the Work, the planned quantity of each type of operated equipment utilized each month, and all changes to the criteria for mobilizing and demobilizing each piece of equipment to and from the site. Identify actual and potential equipment resource problems. A summary of the actual equipment utilized over the past month.

f. Progress Delays.

The Contractor shall identify and promptly report to the Engineer all schedule and progress delays during the prosecution of the work. The Contractor shall promptly take appropriate action to develop a Recovery Schedule in the form of a revised Baseline Schedule whenever the actual physical progress is behind schedule, as compared to the Current Baseline Schedule, or whenever requested by the Engineer.

At a minimum, the Contractor shall submit a Recovery Schedule whenever the Project Schedule Update becomes thirty (30) or more Days late to any Milestone(s) designated in section 108.03, Milestones. The Proposed Baseline Schedule Revision shall be in accordance with corresponding section contained herein. The development and submission of a Recovery Schedule does not relieve the Contractor from continuing with the submission of the Project Status Schedule Submittals.

The submission of the Recovery Schedule shall be at no cost to the Engineer and shall be submitted within (30) days of the Project Schedule Update. The Recovery Schedule shall demonstrate a clear procedure for bringing the Project into compliance with a time line acceptable to the Engineer.

The Department may request a Recovery Schedule due to a delay that is not the fault of the Contractor. Cost associated with the development of these Schedules will be considered a reimbursable expense. Normal adverse weather shall be anticipated by, and planned for by the Contractor. Delays due to such weather events are unacceptable. Failure to submit such a Recovery Plan shall provide a basis for future Payment Application withholdings, either in whole, or in part, by the Engineer.

1. Baseline Schedule Revisions.

In the event of a significant delay, or changes to the Project's Schedule as determined by the Engineer, or any situation where time needs to be recovered, a Revised Baseline Schedule may be required.

Baseline Schedule Revision Submittals shall include a comprehensive listing of all activities added to or deleted from the Current Baseline Schedule of Record as well as a complete listing of all logic and activity relationship changes which have been made. All changes in the schedule must be fully described in an accompanying narrative. No Baseline Schedule Revision Submittal will be accepted unless it satisfies the following requirements:

- Any out-of-sequenced logic is corrected or explained to the satisfaction of the Engineer.
- Start and Finish dates are verified for accuracy.
- The Schedule accurately reflects the Contractor's plan (including accurate logic and durations) for completing the remaining work.

All changes from the accepted Baseline Schedule to the proposed Revised Baseline Schedule must be identified and accepted by the Engineer prior to incorporation into the Revised Schedule. Any

proposed changes and/or revisions to the Current Baseline Schedule accepted by the Engineer pursuant to its review of a Proposal Schedule (definition required) submitted by the Contractor shall be incorporated into the Current Baseline Schedule and submitted as a Baseline Schedule Revision Submittal. A Baseline Schedule Revision Submittal shall be due within 5 days following the Engineer's acceptance of the proposed schedule changes and/or revisions, as submitted in a Proposal Schedule, and shall consist of the requirements of the Baseline Schedule, as supplemented below. The Baseline Schedule Revision shall include a cost distribution for added work and/or costs for review and acceptance by the Engineer.

Once a Baseline Schedule Revision Submittal is accepted by the Engineer it shall become the Current Baseline Schedule Revision of Record (and be used for subsequent Schedule Update Submittals), and shall be referred to by its revision number.

Except as otherwise designated by Change Order, no Current Baseline Schedule Revision that extends performance beyond any Contract Time and/or Contract Milestone(s) shall qualify as a Current Baseline Schedule Revision of Record that would allow it to be used to demonstrate entitlement to a Time Extension. In no case shall a Schedule Update be construed as a Baseline Schedule Revision of Record unless it is specifically submitted and accepted as such by the Engineer.

108.04 LIMITATION OF OPERATIONS. The Contractor shall conduct the work to assure the least interference with traffic. The Contractor shall have due regard to the location of detours and to the provisions for handling traffic. The Contractor shall not open up work to the prejudice or detriment of work already started or completed. The Engineer may require the Contractor to finish a section on which work is in progress before work is started on any additional sections if the opening of such section is essential to public convenience. Any extra costs will be considered under **Subsection 104.04; Alterations in the Plans or Details**.

108.05 CHARACTER OF WORKERS. The Contractor shall employ sufficient labor, supervision, and equipment for prosecuting the several classes of work to full completion in the manner and time required by the Contract.

All workers shall have sufficient skill and experience to perform properly the work assigned to them. Workers engaged in special work or skilled work shall have sufficient experience in such work and in the operation of the equipment required to satisfactorily perform such work.

Any person employed by the Contractor or by any subcontractor who does not perform the work in a proper and skillful manner or is intemperate or disorderly shall, at the written request of the Engineer, be removed forthwith by the Contractor or subcontractor employing such person, and shall not be employed again in any portion of the work without the approval of the Engineer.

Should the Contractor fail to remove such person or persons as required above, or fail to furnish suitable and sufficient personnel for the proper prosecution of the work, the Engineer may withhold progress payments from the Contractor which are or may become due, and suspend the work by written notice until such orders are complied with.

108.06 METHODS AND EQUIPMENT. All equipment which is proposed to be used on the work shall be of sufficient size and in such mechanical condition as to meet requirements of the work and to

produce a satisfactory quality of work. Equipment used on any portion of the project shall not cause injury to the roadway, adjacent property, or other highways.

When the methods and equipment to be used by the Contractor are not prescribed in the Contract, the Contractor shall use any methods or equipment that will accomplish the contract work in conformity with the requirements of the Contract.

When the Contract specifies the use of certain methods and equipment, these methods and equipment shall be used unless others are approved by the Engineer. If the Contractor desires to use a method or type of equipment other than those specified in the Contract, it may request approval from the Engineer for such use. The request shall be in writing and shall include full description of the methods and equipment proposed for use and the reasons for making the change. If approval is granted, it will be on the condition that the Contractor will be responsible for producing construction work in conformity with Contract requirements. If, after trial use of the substituted methods or equipment, the Engineer determines that the work produced does not meet Contract requirements, the Contractor shall discontinue the use of the substitute method or equipment and shall complete the remaining work with the specified methods and equipment. The Contractor shall remove the deficient work and replace it with work of specified quality, or take such other corrective action as the Engineer may direct. No change will be made in the basis of payment for the construction items involved nor in contract time as a result of approving a change in methods or equipment.

108.07 DETERMINATION AND EXTENSION OF CONTRACT TIME.

a. Completion Time. The number of days allowed for the completion of work, or date by which the work shall be completed, will be stated in the Proposal and Contract Agreement, and will be known as the "Contract Time."

The time for completion stated in the Contract, is expressed as a fixed calendar date, and is based on the original quantities as defined in **Subsection 102.03; Interpretation of Quantities in Bid Schedule**. If satisfactory completion of the Contract requires work to be performed in greater quantities than those set forth in the Contract Documents, and the Contractor shall show to the satisfaction of the Engineer that the additional work effects his schedule and contract completion date(s), the time allowed for completion shall be increased on a basis corresponding with the new contract schedule.

The time for completion stated in the Contract has been developed on the assumption that work will be suspended during winter shutdown, i.e., the period from December 15th through the following April 15th unless otherwise specified in the contract documents.

b. Delays. If the Contractor finds it beyond their control to complete the work within the contract time as specified, or as extended in accordance with the provisions of this Subsection, the Contractor may, at any time prior to the expiration of the contract time, make a written request to the Engineer. The Contractor's claim that insufficient time was specified is not a valid reason for extension of time.

The Contractor shall be responsible for notifying the Resident Engineer within thirty (30) calendar days of any Department action or omission which the Contractor believes has delayed or may delay the project. Notification and documentation of the delays shall be in accordance with **Section 105.20 Project Delays.** Such notification shall be a precondition to consideration of an extension of time.

If the Engineer determines that the work was delayed because of conditions beyond the control and without the fault of the Contractor, the time for completion may be extended for such period as conditions justify.

c. Requirements for Time Extension Request. The Contractor's request shall be submitted as a comprehensive Time Extension Request Package. It shall include a narrative, project schedules, copies of all supporting documentation, and related correspondence. The submissions shall be considered a single package and all information shall mutually substantiate the requested extension of time.

1. At a minimum the narrative shall include the following:

(a) Detailed project history including overall project performance by the Contractor, subcontractors, the Department, and third parties that affected the necessity for the time extension request.

(b) Identification, description, and documentation for each delay issue. This shall include the circumstances which occurred resulting in the delay, the responsible parties for the delay and when the Contractor notified the Department regarding the delay. The number of calendar days each delay impacted each milestone shall be calculated and reported.

(c) Identification, description, and documentation for each mitigation action. This shall include the actions taken by each party to mitigate delays, the dates of such actions, and the resulted calendar days which were gained or mitigated by such actions.

2. At a minimum, project schedules shall be included in the Time Extension Package to substantiate the delays and mitigation actions to the project. Engineer Accepted Schedules shall be referenced as is; schedules either Accepted as Noted, Not Accepted, or Rejected shall be corrected before for use in the delay analysis. The number of days requested shall be substantiated by the project schedules.

3. At a minimum the project documentation and correspondence shall be included in the submitted Time Extension Package. This documentation shall include letters, memos, directives, field notes, emails, etc which substantiates any delays or mitigation detailed in the narrative.

108.08 FAILURE TO COMPLETE ON TIME.

a. Phased Completion, Interim Completion and Substantial Completion. For each day, including work days, Saturdays, Sundays, and Holidays, that any unit or portion of the work shall remain uncompleted as defined by **Subsection 105.17; Acceptance, Para. a., Partial Acceptance**, the applicable Daily Charge will be deducted from any money due the Contractor, not as a penalty but as liquidated damages. The Job Specific Phased and Interim Completion Dates and Associated Liquidated Damages are defined in **Special Provision Code 108.1000; Prosecution and Progress**.

An adjustment of the contract time for completion of the work granted under the provisions of **Subsection 108.07** hereto will be considered in the assessment of liquidated damages.

Permitting the Contractor to continue and finish the work, or any part of it, after the contract time, or any extensions thereof, has passed will not waive the Department's rights under the Contract. Unless otherwise specified, liquidated damages will not be assessed during the winter shutdown period, i.e., December 15th through the following April 15th.

b. Final Completion. For each day, including work days, Saturdays, Sundays, and Holidays, that any work shall remain uncompleted after the time established for completion of the work in **Subsection 105.17; Acceptance, Para. b, Final Acceptance**, the applicable Daily Charge specified below, will be deducted from any money due the Contractor, not as a penalty, but as liquidated damages. An adjustment of the contract time for completion of the work granted under the provisions of **Subsection 108.07** hereto will be considered in the assessment of liquidated damages.

Permitting the Contractor to continue and finish the work, or any part of it, after the contract time or any extensions thereof, has passed will not waive the Department's rights under the Contract. Unless otherwise specified, liquidated damages will not be assessed during the winter shutdown period, i.e., December 15th through the following April 15th.

Rates for liquidated damages will be established in accordance with the Schedule. When the contract time is either the calendar day or fixed calendar day basis, the schedule for calendar days shall be used. When the contract time is on a work day basis, the schedule for work days will be used.

Schedule of Liquidated Damages

Original Contract Amount		**Daily Charge**	
From More Than	**To and Including**	**Calendar Day or Fixed Date**	**Work Day**
$ 0	$ 25,000	$200.00	$250.00
25,000	50,000	300.00	400.00
50,000	100,000	450.00	600.00
100,000	500,000	550.00	750.00
500,000	1,000,000	900.00	1,250.00
1,000,000	2,000,000	1,200.00	1,650.00
2,000,000	4,000,000	1,500.00	2,050.00
4,000,000	6,000,000	1,750.00	2,450.00
6,000,000	10,000,000	2,250.00	3,150.00
10,000,000	-------	2,650.00	3,700.00

108.09 DEFAULT OF CONTRACT

a. Conditions. If the Contractor;

1. Fails to begin the work under the Contract within the time specified in the Notice to Proceed, or

2. Fails to perform the work with sufficient workers and equipment or with sufficient materials to assure the prompt completion of said work, or

3. Fails to perform the work in accordance with the contract requirements and/or refuses to remove and replace rejected materials or unacceptable work, or

4. Discontinues the prosecution of the work, or

5. Fails to resume work that has been discontinued within a reasonable time after notice to do so, or

6. Becomes insolvent or is declared bankrupt, files a voluntary petition for bankruptcy under the Federal Bankruptcy Act, or commits any act of bankruptcy or insolvency, or

7. Allows any final judgment to remain unsatisfied for a period of 10 days, or

8. Is a party to fraud, or

9. Makes an assignment of the Contract for the benefit of creditors, or

10. Fails to comply with contract requirements regarding minimum wage payments or EEO requirements, or

11. Fails to carry on the work in an acceptable manner in accordance with the Contract requirements; the Engineer may declare the Contractor to be in default of the Contract and shall give notice in writing to the Contractor and the Surety of such default, advising the Contractor of actions required to remedy said default.

If the Contractor or Surety, within a period of 10 days of receipt of such notice, does not proceed in accordance therewith, then the Department will have full power and authority, without violating the Contract, to assume prosecution of the work from the Contractor. The Department may appropriate or use the Contractor's materials and equipment at the site as may be suitable for use in the project and may enter into an agreement with another contractor for the completion of said Contract according to the terms and provisions thereof, or use such other methods as in the opinion of the Engineer will be required for the completion of Contract.

All costs and charges incurred by the Department as a result of the default, including the cost of completing the work under Contract and any applicable liquidated damages, will be deducted from any monies due or to become due the Contractor. If such costs exceed the sum which would have been payable under the Contract, then the Contractor and the Surety shall be liable and shall pay to the Department the balance of such costs in excess of the contract amount.

If it is determined, after termination of the Contractor's right to proceed, that the Contractor was not in default, the rights and obligations of the parties will be the same as if the termination had been issued for the convenience of the Department in accordance with **Subsection 108.10**. Thus, damages to

which a Contractor may be entitled as a result of the improper default termination will be limited to appropriate amounts for the items listed in **Subsection 108.10; Termination of Contract**.

108.10 TERMINATION OF CONTRACT.

a. Reasons for Termination. The Department may terminate the entire Contract, or any portion thereof, when the Contractor is prevented from proceeding with the prescribed work for any of the following reasons:

1. An Executive Order of the President of the United States with respect to the prosecution of war; in the interest of national defense; or any civil emergency or natural disaster.

2. An Executive Order of the Governor of the State with respect to a natural disaster or civil emergency.

3. Court orders relating to energy consumption, and orders or injunctions obtained by third party action resulting from national or local environmental protection laws.

4. Discovery of unanticipated archaeological artifacts of a significant nature that would require extensive and time-consuming delays in the work for the purposes of identification, evaluation, and possibly recovery.

5. Occurrence of an unanticipated environmental situation of a significant nature that would require extensive and time-consuming delays in the work for the purposes of identification, evaluation, and possibly mitigation.

6. Any other circumstances beyond the control of either the Department or the Contractor that precludes the orderly prosecution or completion of the work and that is in the public interest.

The Engineer shall terminate the Contract by delivering to the Contractor a Notice of Termination which shall specify the extent of the termination, the reasons therefore, and the effective date thereof.

b. Termination Procedures. After receipt of a Notice of Termination, and except as directed by the Engineer, the Contractor shall immediately proceed with the following obligations:

1. Stop work as specified in the notice.

2. Place no further subcontracts or orders (referred to as subcontracts in this clause for materials, services, or facilities, except as necessary to complete the continued portion of the Contract.

3. Terminate all subcontracts to the extent they relate to the work terminated.

4. With approval or ratification to the extent required by the Engineer, settle all outstanding liabilities and termination settlement proposals arising from the termination of subcontracts; the approval or ratification will be final for purposes of this clause.

5. As directed by the Engineer, transfer title and deliver to the Department the fabricated, partially fabricated, or unfabricated parts, work in process, completed work, supplies, and other material produced or acquired for the work terminated; and the completed or partially competed plans, drawings, information, and other property that, if the Contract had been completed, would be required to be furnished to the Department.

6. Complete performance of the work not terminated.

7. Take any action that may be necessary, or that the Engineer may direct, for the protection and preservation of the property related to this Contract that is in the possession of the Contractor and in which the Department has or may acquire an interest.

8. At the direction of the Engineer, acceptable materials obtained by the Contractor for the Project but which have not been incorporated therein, may be purchased from the Contractor at actual cost delivered to a prescribed location, or disposed of as mutually agreed.

When the Department orders termination of a Contract, or portion thereof, effective on a certain date, all completed items of work as of that date will be paid for at the contract bid prices. Payment for partially completed work will be made either at agreed prices or in accordance with the subparagraph below entitled, "Contractor and Department Fail to Agree." Items that are eliminated in their entirety by such termination shall be paid for as provided in **Subsection 109.05; Eliminated Items**.

The Contractor shall submit, within 60 days of the effective termination date, a claim for additional damages or costs not covered above or elsewhere in the Contract. Such claim may include such cost items as reasonable idle equipment time, mobilization efforts, bidding and project investigative costs, overhead expenses attributable to the project terminated, legal and accounting charges involved in claim preparation, subcontractor costs not otherwise paid for, actual idle labor cost if work is stopped in advance of termination date, guaranteed payments for private land usage as part of the original Contract, and any other cost or damage for which the Contractor feels reimbursement should be made. The intent of negotiating this claim would be that an equitable settlement be reached with the Contractor. In no event will loss of anticipated profits be considered as part of any settlement.

The Contractor and the Department may agree upon the whole or any part of the amount to be paid because of the termination. The amount may include a reasonable allowance for profit on work performed. The Contract shall be amended, and the Contractor paid the agreed amount.

c. Contractor and Department Fail to Agree. If the Contractor and the Department fail to agree on the whole amount to be paid the Contractor because of the termination of work, the Department shall pay the Contractor the amounts determined as follows, but without duplication of any amounts agreed upon above;

1. For contract work performed before the effective date of termination, the total of the following:

(a) The cost of this work;

(b) The cost of settling and paying termination settlement proposals under terminated subcontracts that are properly chargeable to the termination portion of the Contract; and

(c) A sum, as profit on (a), above, determined by the Department to be fair and reasonable; however, if the Contractor would have sustained a loss on the entire Contract had it been completed, the Department shall allow no profit and shall reduce the settlement to reflect the indicated rate loss.

2. The reasonable costs of settlement of the work terminated, including:

(a) Accounting, legal, clerical, and other expenses reasonably necessary for the preparation of termination settlement proposals and support data;

(b) The termination and settlement of subcontracts (excluding the amounts of such settlements); and

(c) Storage, transportation, and other costs incurred, reasonably necessary for the preservation, protection, or disposition of the termination inventory.

3. Except for normal spoilage, and except to the extent that the Department expressly assumed the risk of loss, the Department shall exclude from the amounts payable to the Contractor, the fair value, as determined by the Department of property that is destroyed, lost, stolen, or damaged so as to become undeliverable to the Department or to the buyer.

4. In arriving at the amount due the Contractor under this clause, there shall be deducted:

(a) All unliquidated advance or other payments to the Contractor under the terminated portion of this Contract;

(b) Any claim which the Department has against the Contractor under this Contract; and

(c) The agreed price for, or the proceeds of sale of materials, supplies, or other things acquired by the Contractor or sold under the provisions of this clause and not recovered by or credited to the Department.

d. Partial Termination. If the termination is partial, the Contractor may file a proposal with the Department for an equitable adjustment of the price(s) of the continued portion of the Contract. The Department shall make any equitable adjustment agreed upon. Any proposal by the Contractor for an equitable adjustment under this clause shall be requested within 90 days from the effective date of termination unless extended in writing by the Engineer.

e. Records. The Department may, under the terms and conditions it prescribes, make partial payments and payments against costs incurred by the Contractor for the terminated portion of the Contract, if the Department believes the total of these payments will not exceed the amount to which the Contractor will be entitled.

The Contractor shall maintain and make available all project cost records to the Department for audit to the extent necessary to determine the validity and amount of each item claimed. This includes all books and other evidence bearing on the Contractor's costs and expenses under this Contract. The Contractor shall make these records and documents available to the Department, at the Contractor's office, at all reasonable times, without any direct charge. If approved by the Department, photographs,

microphotographs, or other authentic reproductions may be maintained instead of original records and documents.

f. Contractual Responsibilities. Termination of a Contract or portion thereof shall not relieve the Contractor of contractual responsibilities for the work completed, nor shall it relieve the Surety of its obligation for and concerning any just claim arising out of the work performed.

SECTION 109

MEASUREMENT AND PAYMENT

109.01 MEASUREMENT OF QUANTITIES. Work completed under the Contract will be measured by the Engineer according to United States standard measure, or by the metric system when the Contract so provides.

A station when used as a definition or term of measurement will denote 100 linear feet.

The method of measurement and computations to be used to determine quantities of materials furnished and work performed under the Contract will be those methods generally recognized as conforming to good engineering practice.

Unless otherwise specified, longitudinal measurements for area computations will be made horizontally, and no deductions will be made for individual fixtures in the roadway having an area of 9 square feet or less. Unless otherwise specified, transverse measurements for area computations will be the neat dimensions shown on the Plans.

Structures will be measured according to neat lines shown on the Plans or as altered to fit field conditions.

Items which are measured by the linear foot, such as pipe culverts, curb, guardrail, underdrains, etc., will be measured parallel to the base or foundation upon which such structures are placed, unless otherwise shown on the Plans.

In computing volumes of excavation the average end area method, or other acceptable methods, will be used.

The thickness of plates and galvanized sheet used in the manufacture of corrugated metal pile, metal plate pipe culverts and arches, and metal cribbing will be specified and measured in decimal fractions of inches.

The term "gauge" shall mean the standard gauges as established by AASHTO, ASTM, U.S.A.S.I. or Manufacturer's standards, in the order of precedence listed.

The term "ton" will mean the short ton consisting of 2,000 pounds avoirdupois. Materials which are measured or proportioned by weight shall be weighed on accurate, approved scales by competent, qualified personnel at locations designated by the Engineer. If material is shipped by rail, the car weight

may be accepted provided that payment is made only for the actual weight of such material. However, car weights will not be acceptable for material that is passed through mixing plants. Trucks used to haul material being paid for by weight shall be weighed empty daily at such times as the Engineer directs. Each truck shall bear a plainly legible identification mark.

Materials to be measured by volume in the hauling vehicle shall be hauled in approved vehicles and measured in such vehicles at the point of delivery. Vehicles for this purpose may be of any size or type acceptable to the Engineer, provided that the body is of such shape that the actual volume may be readily and accurately determined. Vehicles shall be loaded to at least their water level capacity and all loads shall be leveled when the vehicles arrive at the point of delivery. However, any "heap" above the water level line may be computed for quantity if authorized by the Engineer.

When requested by the Contractor and approved in writing by the Engineer, material specified to be measured by the cubic yard may be weighed and such weights will be converted to cubic yards for payment purposes. Factors for conversion from weight measurement to volume measurement will be determined by the Engineer and shall be acceptable to the Contractor before such method of measurement of quantities is employed.

Bituminous materials will be measured as indicated in the Proposal. Volumes will be measured at 60°F or will be corrected to the volume at 60°F using ASTM D1250 for asphalts or ASTM D633 for tars.

Net certified scale weights, or weights converted from certified volumes in the case of rail shipments, will be used as a basis of measurement. Such weights, however, shall be subject to correction whenever bituminous material has been lost from the car or the distributor, wasted, or otherwise not incorporated in the work.

When bituminous materials are shipped by truck or transport, net certified weights or volume subject to correction for loss or foaming, may be used for computing quantities.

Cement will be measured by the pound.

Timber will be measured by thousand foot-board measure (M.F.B.M.) actually incorporated in the structure. Measurement will be based on nominal widths and thicknesses and the extreme length of each piece.

The term "lump sum" when used in the Bid Schedule as an item of payment will mean complete payment for the work so described in the Contract.

When a complete structure or structural unit (in effect, "lump sum" work) is specified as the unit of measurement, the unit will be construed to include all necessary fittings and accessories.

Rental of equipment will be measured by time in hours of actual working time and necessary travel time within the limits of the project. If special equipment has been ordered by the Engineer in connection with force account work, travel time and transportation to the project will be measured. If equipment has been ordered held on the job on a standby basis by the Engineer, half-time rates for the equipment will be paid.

When standard manufactured items are specified such as fence, wire, plates, rolled shapes, pipe conduit, etc., and these items are identified by gauge, unit weight, section dimensions, etc., such identification will be considered to be nominal weights or dimensions. Unless more stringently controlled by tolerances in cited specifications, manufacturing tolerances established by the respective industries will be accepted.

Scales for the weighing of highway and bridge construction materials that are required to be proportioned or measured and paid for by weight, shall be furnished, erected, and maintained by the Contractor, or be certified permanently installed commercial scales.

Scales shall be accurate within ½ of 1 percent of the correct weight throughout the range of use. The Contractor shall have the scales checked under the observation of the Inspector before beginning work and at such other times as requested. The intervals shall be uniform in spacing throughout the graduated or marked length of the beam or dial and shall not exceed 1/10 of 1 percent of the nominal rated capacity of the scale; but not less than 1 pound. The use of spring balances will not be permitted.

Beams, dials, platforms, and other scale equipment shall be arranged so that the operator and inspector can safely and conveniently view them.
Scale installations shall have available ten standard 50 pound weights for testing the weighing equipment or suitable weights and devices for other approved equipment.

Scales must be tested for accuracy and serviced before use at a new site. Platform scales shall be installed and maintained with the platform level and rigid bulkheads at each end.

Scales over weighing (indicating more than true weight) will not be permitted to operate and materials received subsequent to the last correct weighing accuracy test will be reduced by the percentage of error in excess of ½ of 1 percent.

In the event inspection reveals the scales have been under weighing, they shall be adjusted and no additional payment to the Contractor will be allowed for materials previously weighed and recorded.

Costs in connection with furnishing, installing, certifying, testing, and maintaining scales; for furnishing check weights and scale house, and for all other items specified in this Subsection for weighing of highway and bridge construction materials for proportioning or payment shall be included in the unit contract prices for the various pay items of the project.

When the estimated quantities for a specific portion of the work are designated as pay quantities in the Contract, they shall be the final quantities for which payment will be made, unless the dimensions of the work shown on the Plans are revised by the Engineer. If revised dimensions result in an increase or decrease in the quantities of work, the final quantities for payment will be revised in the amount represented by the authorized changes.

109.02 SCOPE OF PAYMENT. The Contractor shall receive and accept compensation provided for in the Contract as full payment for furnishing all materials and for performing all work under the Contract in a complete and acceptable manner, and for all risk, loss, damage, or expense of whatever character arising out of the nature or prosecution of the work, subject to the provisions of **Subsections 104.03; Differing Site Conditions** and **107.16; No Waiver of Legal Rights**.

If the "Basis of Payment" clause in the specifications relating to any unit price in the Bid Schedule requires that the said unit price cover and be considered compensation for certain work or material essential to the item, this same work or material will not also be measured or paid for under any other pay item which may appear elsewhere in the Contract.

109.03 COMPENSATION FOR ALTERED QUANTITIES. When the accepted quantities of work vary from the quantities in the Bid Schedule, the Contractor shall accept payment at the original contract unit prices for the accepted quantities of work performed. No allowance will be made for any reason except as provided for in **Subsections 104.03; 104.05; and 104.07; Differing Site Conditions, Extra Work, and Significant Changes in the Character of the Work**, respectively.

109.04 DIFFERING SITE CONDITIONS, CHANGES, EXTRA WORK AND FORCE ACCOUNT WORK.

a. Methods of Payment. Differing site conditions, changes, extra work, and significant changes in the character of the work, all performed in accordance with **SECTION 104; SCOPE OF WORK**, will be paid for in accordance with the following methods as appropriate:

1. Contract unit prices.

2. Unit prices agreed upon in the order authorizing the work.

3. An agreed upon lump sum amount.

4. If directed by the Department, on a Force Account Basis to be compensated in the following manner:

(a) Labor. For all labor and foremen in direct charge of the specific operations, the Contractor shall receive the rate of wage actually paid as shown by its certified payroll, which rate shall be at least the prevailing rate of wage (or scale), for each and every hour that said labor and foremen are actually engaged in the work.

No part of the salary or expenses of anyone connected with the Contractor's forces above the grade of foreman, and having general supervision of the work, will be included in the labor item as specified above.

The Engineer reserves the right to determine the number and type of labor employed.

The Contractor shall receive the actual costs paid to, or in behalf of, workers by reason of subsistence and travel allowances, health and welfare benefits, pension fund benefits or other benefits, when such amounts are required by collective bargaining agreement or other employment contract generally applicable to the classes of labor employed on the work.

An amount equal to 20 percent of the sum of the above items will also be paid the Contractor.

(b) Bond, Insurance and Tax. For property damage, liability, worker's compensation insurance premiums, unemployment insurance contributions, and social security taxes incurred on force account work, the Contractor shall receive the actual cost, to which cost a surcharge of 6-percent will be added. The Contractor shall furnish satisfactory evidence of the rate or rates paid for such bonds, insurances and taxes.

(c) Materials. For materials accepted by the Engineer and used in the work, the Contractor shall receive the actual cost of such materials delivered to the site, including transportation charges paid (exclusive of machinery rentals as hereinafter set forth), to which cost a surcharge of 15 percent will be added. The Contractor will not be reimbursed for any penalty or carrying charge incurred due to late or delayed payment for materials used in the work.

(d) Equipment. For any machinery or special equipment (other than small tools) including transportation cost, the use of which has been authorized by the Engineer, the Contractor shall receive either the "hourly rental rates" as prescribed herein by the Department, or the actual documented cost plus an amount equal to 10 percent of said actual documented cost, whichever is less. Under no circumstance shall the payment exceed the replacement cost of the equipment.

All rental rates shall include the estimated operating cost as indicated for that equipment in either the Rental Rate Blue Book or the Rental Rate Blue Book for Older Equipment, including the Rate Adjustment Tables approved for projects wholly or partially funded by the Federal Highway Administration (FHWA). Operators' wages are not included in the estimated operating cost and are paid separately, except for certain specified equipment in which the operator's wages are included.

The "hourly rental rate" for an individual piece of equipment shall be determined by dividing the associated monthly rate, modified by the Rate Adjustment Tables, as contained in the Rental Rate Blue Book by one hundred seventy-six (176). There will be no adjustment to the hourly rate for the period of use.

For rented equipment, the cost shall be based on the actual documented cost plus an amount equal to 10-percent of said actual documented cost, subject to the conditions set forth below. The actual documented cost shall consist of the paid invoice for rented equipment plus other documented operating costs (i.e. fuel, maintenance, repairs, etc.).

Actual documented costs plus 10 percent of said costs shall not exceed the cost as calculated from the RENTAL RATE BLUE BOOK or the RENTAL RATE BLUE BOOK FOR OLDER CONSTRUCTION EQUIPMENT. The Contractor shall submit documentation for both the hourly rental rates and actual documented costs to determine that the actual documented costs plus 10 percent of said costs does not exceed the calculated rental rate costs. No percentage surcharges will be added to the "Blue Book" rates as prescribed herein for rented equipment.

For equipment which is already on the project, the rental period shall start when such equipment is ordered to work by the Engineer, and shall continue until ordered to stop work.

For equipment which has to be brought to the project specifically for use on force account work, the State will pay all loading and unloading costs, and all transportation costs to and from the project, including assembling and dismantling, provided, however, that the cost of return transportation shall not exceed that of moving the equipment to the project. Loading, unloading and transportation costs will not

be paid if the equipment is used for work other than force account work while on the project. The rental period shall start at the time the equipment is ready for operation, and shall extend during the period of time the equipment is actually utilized on force account work. The rental period shall end when the equipment is released by the Engineer.

All equipment, including trucks, shall, in the judgment of the Engineer, be in good working condition and suitable for the purpose intended. The Engineer reserves the right to determine the number of units of the various types of equipment to be employed on force account work. The manufacturer's model identification shall be the basis for identifying the type of equipment for payment purposes. Certification for the model year of the equipment will be required.

(e) Miscellaneous. No additional allowance will be made for general superintendence, the use of small tools, or other costs for which no specific allowance is herein provided.

(f) Compensation. The Contractor's representative and the Engineer shall daily compare records of work completed on a force account basis. The Engineer will then prepare the daily work sheets and said sheets will be signed by the Contractor's representative no later than noon of the next working day.

(g) Statements. No payment will be made for work performed on a force account basis until the Contractor has furnished the Engineer with six copies of itemized statements of the cost of such work, incurred on a daily basis, and detailed as follows:

(1) Name, classification, date, daily hours, total hours, rate and extension for each laborer and foreman.

(2) Designation, dates, daily hours, total hours, rental rate, and extension for each unit of machinery and equipment.

(3) Quantities of materials, prices, and extensions.

(4) Transportation of materials.

(5) Cost of property damage, liability and worker's compensation insurance premiums, unemployment insurance contributions, and social security taxes.

Statements shall be accompanied and supported by certified payrolls, and receipted invoices for all materials used and transportation charges. However, if materials used on the force account work are not specifically purchased for such work but are taken from the Contractor's stock, then in lieu of the invoices, the Contractor shall furnish an affidavit certifying that such materials were taken from its stock, that the quantity claimed was actually used, and that the price and transportation claimed represent the actual cost to the Contractor.

109.05 ELIMINATED ITEMS. Should any items contained in the Contract be found unnecessary for the proper completion of the work, the Engineer may, upon written order to the Contractor, eliminate the items from the Contract, and the action shall not invalidate the Contract. When a Contractor is notified of the elimination of items, the Contractor will be reimbursed for actual work performed and all costs incurred, including mobilization of materials prior to said notification.

109.06 PARTIAL PAYMENTS.

a. Amount. Partial payments will be made bi-weekly as the work progresses. The amount of the partial payments shall be 97 percent of the Contract price for the work performed during the previous payment period, all as measured and/or estimated and accepted by the Engineer. Partial payment will be subject to a 3 percent retainage.

Retainage will be released when all items on the punch list and the required documentation have been addressed to the satisfaction of the Engineer.

No partial payments shall be made when, in the judgment of the Engineer, the work has not proceeded according to provisions of the Contract. Partial payments shall not be construed as an acceptance by the Department of any materials furnished or work performed.

No partial payments shall be made on perishable plant materials until such plant materials are planted as specified in the Contract.

Upon written request from the Contractor, supported by delivery invoices, and for those conditions outlined below, the Engineer may allow partial payment on such approved materials, supplies and equipment as are delivered to an approved site in acceptable condition. Such materials, supplies and equipment, as yet not incorporated into the work, shall be identified, set aside and suitably stored at or near the site of the work.

b. Conditions. The conditions under which the Engineer may allow partial payments for those materials, supplies, and equipment not yet incorporated into the work include any of the following:

1. The schedule of completion of the work has been terminated by authorized suspension of Contract work (pending final settlement), or

2. The schedule of completion of the work has been hindered and delayed by seasonal closing of the project or by similar causes over which the Contractor has no control, or

3. When, in the opinion of the Engineer, the advance delivery of such materials is in the best interest for the timely completion of the project.

c. Maximum Payment. Under these conditions partial payments for such materials, supplies and equipment furnished at an approved site shall not exceed the lesser of the following amounts.

1. 100 percent of the actual cost incurred by the Contractor, or

2. 80 percent of the amount generated by the quantity of materials so delivered and accepted, multiplied by the unit price bid for such materials as contained in the Bid Schedule.

Such payment shall be made as a partial payment under the related item or items by adjustment of the quantity progressively allowed. The Contractor must furnish a paid invoice for the furnished

materials, supplies or equipment within thirty (30) days after receiving the partial payment. Otherwise, the amount of the partial payment will be deducted from subsequent invoices.

109.07 PARTIAL PAYMENT OF LUMP SUM ITEMS. Each bi-weekly period the Engineer and the Contractor will consult and subsequently agree on the progress of work performed under those lump sum items indicated in the Bid Schedule. Partial payments for the completed and accepted portions of such work will be made to the Contractor based on the Engineer's estimate of the value of said completed work.

Prior to award of the Contract, or in any case within ten (10) calendar days after the date of the Notice of Award, the Contractor shall submit to the Engineer for approval two copies of the breakdown of each lump sum bid item that appears in the Bid Schedule, (excluding the Mobilization item). The breakdown of Lump Sum-Superstructure and Lump Sum-Substructure items shall include only those items listed on the Plans, and shall include the Contractor's verified quantities it used in preparing its bid. All other additional costs (such as engineering, shop drawings, formwork, equipment, etc.) to complete those items of work shall be included and distributed in the breakdown of those listed items. For other lump sum items not identified on the Plans, the Contractor shall provide a breakdown of the various items that constitute the respective lump sum work items.

The Engineer will use as a guide the Lump Sum breakdowns submitted by the Contractor if they fairly represent the cost of the various items of work. If, in the opinion of the Engineer, the prices submitted by the Contractor do not fairly represent the cost of the various items of work, the Engineer may substitute other prices that do fairly represent the cost of such work.

109.08 PAYMENT OF WITHHELD FUNDS.

a. Payment. Upon request, the Department will make payment of funds withheld from progress payments if the Contractor deposits, in escrow, securities eligible for the investment of State funds or bank certificates of deposit, upon the following conditions:

1. The Contractor shall bear the expenses of the Department and the State Treasurer in connection with the escrow deposit made.

2. Securities or certificates of deposit to be placed in escrow will be subject to the approval of the Department and, unless otherwise permitted by the escrow agreement, shall be of a value of at least 100 percent of the amounts of retention to be paid to the Contractor pursuant to this Section.

3. The Contractor shall enter into an escrow agreement satisfactory to the Department.

4. The Contractor shall obtain the written consent of the Surety to the agreement.

109.09 ACCEPTANCE AND FINAL PAYMENT. When the project has been accepted as provided in **Subsection 105.17**, the Engineer will prepare the final estimate of work performed. If the Contractor approves the final estimate or files no claim or objection to the quantities therein within 30 days of receiving the final estimate, the Department will process the estimate for final payment. With approval of

the final estimate by the Contractor, payment will be made for the entire sum found to be due after deducting all previous payments and all amounts to be retained or deducted under the provision of the Contract.

If the Contractor files a claim in accordance with Contract requirements, it shall be submitted in writing in sufficient detail to enable the Engineer to ascertain the basis and amount of such claim. Upon final adjudication of the claim, any additional payment determined to be due the Contractor will be placed on a supplemental estimate and processed for payment.

All prior partial estimates and payments will be subject to correction in the final estimate and payment.

109.10 COMPENSATION FOR PROJECT DELAYS.

a. Compensable Delays. The Department will provide an equitable adjustment to the Contractor for those delays created by the Department's acts or omissions. Unless otherwise specified, the Contractor assumes the risk of damages from all other causes of delay.

The term "delay" shall be deemed to mean any event, action, force or factors which extends the Contractor's time of performance of the Contract. This Subsection is intended to cover all such events, actions, forces or factors, whether they be styled "delay," "disruption," "interference," "impedance," "hindrance" or otherwise.

Strict compliance with the provisions of this Subsection will be an essential condition precedent to any equitable adjustment for delays.

b. Limitation of Costs. Only the additional actual costs associated with the following items will be recoverable by the Contractor as an equitable adjustment for delays.

1. Documented and substantiated additional or escalated job site non-salaried labor expenses.

2. Documented and substantiated additional or escalated costs for materials.

3. Documented and substantiated equipment costs or escalated equipment costs. When measuring additional equipment expenses (i.e., ownership expenses) arising as a direct result of a delay caused by the Department, use actual records kept in the usual course of business, and measure increased ownership expenses pursuant to generally accepted accounting principles.

4. Documented and substantiated extended job-site overhead to include those costs necessary to maintain the job site during the delay such as field office (inclusive of equipment, copy and fax machines, computers etc), field office utility bills (i.e. electricity, gas, water, etc.), field office supplies and janitorial services, and security. Under no circumstances will any of the contractor's labor costs (inclusive of extended field labor) be paid under extended job-site overhead. Labor costs are paid subject to the conditions of No.b.1 and No.b.5 of this section.

5. An additional surcharge of 10 percent of the total of items 1, 2, 3, and 4, to account for home office overhead as well as all salaried labor (both home office and extended field supervision), and profit.

Note: Where documentation, payment for equipment, and/or cost substantiation is specified, the Contractor shall adhere to the requirements in **Section 109.04** of these Specifications. Payment for costs submitted for reimbursement will be made only to the extent that the requirements of **Section 109.04** are met to the satisfaction of the Engineer.

c. Waiver of Liability. The parties agree that, in any adjustment for delay costs, the Department will have no liability for the following items of damages or expense:

1. Profit in excess of that provided herein;

2. Loss of profit;

3. Labor inefficiencies;

4. Home office overhead in excess of that provided herein;

5. Consequential damages, including but not limited to loss of bonding capacity, loss of bidding opportunities and insolvency;

6. Indirect costs or expenses of any nature;

7. Attorneys fees, claims preparation expenses or costs of litigation.

109.11 PROMPT PAYMENT PROCEDURES. In accordance with Title 42, Chapter 11.1-1 of the General Laws, all invoice vouchers submitted by the Contractor will be paid within thirty (30) days, provided however, that according to 42-11.1-5(B)2, the thirty (30) day period will not commence until the Department has reviewed and accepted all invoice documentation in its proper and approved form.

109.12 SUBCONTRACTOR PROMPT PAYMENT. The Prime Contractor shall make prompt payment for satisfactory subcontract work for which the Department has made partial or full payment. The term "Subcontractor" as used herein, is defined in **Subsection 101.70; Subcontractor**.

When a Subcontractor has not received payment for work paid to the Prime Contractor within 30-days from receipt of the actual check by the Prime Contractor from the State, a formal complaint may be filed under the following procedures:

a) The Subcontractor will send written notification to the Department, including contract item numbers, date work performed, a copy of the invoice(s) from the Subcontractor to the Prime, and a copy of the Progress Payment where payment to the Prime Contractor was included. The latter item may be obtained from the Department's field supervisor or Construction Office. If the Subcontractor has not provided a payment/performance bond for this work to the contractor, then the formal complaint must also include verification that all suppliers and other debts on these items have been paid or documented reasons for non-payment acceptable by the Department. Failure to provide this verification will be considered "good cause" for postponement of payment by the Prime Contractor.

b) The Department will notify the Prime Contractor of the formal complaint in writing within 15 days and will proceed to withhold an amount equal to the previous payment(s) made to the Prime

Contractor for the specific subcontractor's work. The Prime Contractor must submit written documentation to the Department demonstrating good cause for not making the required payment within 15 days. If the Department does not receive the required documentation within the required 15 days or does not accept the Contractor's good cause justification, the Department will withhold or continue to withhold an amount equal to all previous payments to the Prime Contractor for the specific Subcontractor's work until the Department has verified payment to the Subcontractor. If the Department accepts the Prime Contractor's good cause justification, it will notify the Subcontractor of its decision that this is categorized as a dispute and payment to the Prime Contractor will be released. The Subcontractor and Prime Contractor may solve their dispute in any fashion they so choose (arbitration, mediation, litigation, etc.). The cost of any such arbitration/mediation shall be borne by both parties at an equal share or as otherwise provided for in any agreement between the parties.

c) Should the two parties enter into a payment agreement/settlement, the Department will only release previous monies held in accordance with the agreement/settlement. Should the Prime Contractor default again, the Department will contact the bonding company and request complete payment within 15 days. Should the bonding company and/or Prime Contractor fail to make complete payment after a 15-day period, all progress payments to the Prime Contractor will stop until the subcontractor is paid and the dispute is resolved to the satisfaction of the Department.

Any delays and/or claims resulting from the actions taken by the Department under this Specification will not be the responsibility of the State.

DIVISION II

CONSTRUCTION DETAILS

PART 200

EARTHWORK AND EROSION CONTROL

SECTION 201

SITE PREPARATION

201.01 DESCRIPTION. This work consists of the performance of actions that are required to clear and prepare the site for subsequent construction operations. These actions all have a common characteristic; they involve the removal and legal disposal of both designated vegetative materials and man-made objects and facilities. These actions include, but are not limited to, the following: clearing and grubbing; cutting and removing isolated trees and stumps; partial or complete removal of isolated tree stumps; trimming tree roots; removal and disposal of culverts, masonry; drainage and utility structures; pipe; rigid and flexible pavement; granite, concrete and bituminous curbing; fences and railings; guardrail of all types; underground and above-ground storage tanks; miscellaneous items such as highway bounds and signs; demolition of buildings and structures; and all other obstructions or undesirable materials within the right-of-way. All such materials, objects and facilities shall be removed and legally disposed of.

The Contractor shall be compensated for clearing and preparing the site for construction operations through individual Proposal items; one such item for each removal and disposal action.

The following Subsections contain descriptions of some of the most common removal and disposal actions.

201.01.1 Clearing and Grubbing. This work consists of cutting, removing from the ground, and disposing trees, stumps, brush, shrubs, hedges, roots and other vegetation which occur within the right-of-way and interfere with excavation, embankment, fencing, clear vision, or are otherwise considered objectionable. This work also includes the preservation from injury or defacement of all vegetation and objects outside clearing limits.

201.01.2 Cutting and Removing Isolated Trees and Stumps. This work consists of cutting and removing designated isolated trees and stumps in excess of 4 inches in diameter (measured at 4 inches above existing ground) which are located within the general area of construction work but which are not located within the areas specified for Clearing and Grubbing.

201.01.3 Partial Removal of Isolated Tree Stumps. This work consists of the partial removal of designated isolated tree stumps which are located within the limits of the project.

201.01.4 Metal Frames, Covers or Grates. This work consists of the removal of metal frames, covers or grates from existing utility and drainage structures.

201.01.5 Culverts, Drainage and Utility Structures. This work consists of the removal, in whole or in part, of culverts, drainage structures such as catch basins, drop inlets and manholes; utility structures such as gas, electric and telephone boxes, manholes and pits; and sewer manholes. The removal of metal frames, covers or grates of drainage structures is not covered under this item, but is included under **Subsection 201.01.4**, above.

201.01.6 Pipe. This work consists of removing all pipe of whatever nature and sizes indicated on the Plans.

201.01.7 Pavement, Sidewalks, and Curbing. This work consists of removing flexible and rigid pavement including surface, base and/or subbase courses; granite, concrete and bituminous curbing; and concrete and bituminous sidewalks as shown on the Plans.

201.01.8 Asbestos Cement Pipe. This work consists of removing existing asbestos cement pipe/duct bank of all types and sizes in strict accordance with these Specifications.

201.01.9 Underground/Above-ground Storage Tanks. This work consists of locating, removing and disposing of existing gasoline and oil storage tanks previously abandoned and left in place, and such other storage tanks as may be encountered in the work, either above or below ground, regardless of size and type. All work will be performed in accordance with both the State of Rhode Island Department of Environmental Management, Division of Water Resources' "Regulations for Underground Storage Facilities Used for Petroleum Products and Hazardous Materials," latest edition, and all other applicable State and Federal laws and regulations.

The removal of cesspools and septic tanks is not covered under this item but is included under **Subsection 201.01.12; Demolition of Buildings.**

201.01.10 Fences, Railings, and Guardrail. This work consists of removing all fences, railings and guardrail of whatever type and sizes indicated on the Plans to be removed.

201.01.11 Miscellaneous Objects. This work consists of removing miscellaneous objects such as mail boxes and posts, road signs, private signs, highway bounds and any other objects not covered by any preceding Subsection, specifically indicated on the Plans to be removed or required to be removed for the construction of the new work.

201.01.12 Demolition of Buildings. This work consists of the demolition of such buildings and their foundations as shown on the Plans. Each such portion of the work shall include the disposal of all outbuildings, such as garages and sheds, adjacent to or a part of the unit designated unless such outbuildings are designated as separate units.

The work shall also include the removal of cesspools, septic tanks, distribution boxes and other such tanks as may be encountered.

The work shall include implementation of rodent control measures for each building before its demolition.

201.02 MATERIALS. For the requirements relating to Common Borrow and Gravel Borrow, see **Subsections 202.02.1 and 202.02.2**, respectively, of these Specifications.

201.03 CONSTRUCTION METHODS. The Contract Documents will provide all necessary information relating to right-of-way and constructions lines, and will designate all trees, shrubs, plants and other objects and facilities to remain within the project limits. The Contractor shall preserve everything designated to remain.

201.03.1 Clearing and Grubbing. All trees, stumps, brush, shrubs, hedges and roots, not designated to remain, but within the fill lines of embankments and less than 3 feet in height to subgrade, shall be cleared and grubbed. When authorized, or when the height of embankment to subgrade exceeds 3 feet, the Contractor may leave stumps provided they do not extend more than 6 inches above the original ground or low water level.

After clearing, and by the end of each day's grubbing operation, the Contractor shall install erosion control measures that are indicated on the Plans or as directed by the Engineer. Such erosion control measures shall be installed in strict accordance with the requirements of **SECTIONS 206, 207,** and **208** of these Specifications, **PERIMETER EROSION CONTROLS, CHECK DAMS**, and **TEMPORARY DEWATERING BASINS**, respectively.

The Engineer may permit sound stumps to be cut off not more than 6 inches above the ground and to be left outside of the construction limits of cut and embankment areas, except in the area to be rounded at the top of back slopes where stumps are to be cut off flush with or below the surface of the final slope line.

Except in areas to be excavated, stump holes and other holes from which obstructions are removed, shall be backfilled with material acceptable to the Engineer and compacted in accordance with **Subsection 202.03.3; Compaction - General**, of these Specifications.

a. Disposal of Perishable Materials. No burning of trees, brush, shrubs, or perishable material will be allowed on any construction project site. The Contractor will not be allowed to haul trees, brush, shrubs or perishable material from the project for the purpose of burning. The Contractor must dispose of the trees, brush, shrubs, or other perishable material by any of the following methods:

1. The Contractor may sell or salvage all merchantable timber in the Clearing and Grubbing area which has not been removed from the right-of-way prior to the beginning of construction.

2. The Contractor may chip trees on the site. All wood chips will become the property of the Contractor and must be removed promptly from the site. When the project plans call for the use of wood chips, the Contractor may stockpile the required quantity on the site at a location approved by the Engineer.

3. Unless otherwise specified in the Contract Documents all trees, brush, shrubs, and other perishable material shall be legally disposed of at locations off the project site. Such disposal shall require the written permission of the property owner on whose property the materials are to be buried and, if necessary, the Rhode Island Department of Environmental Management. The Contractor shall make all necessary arrangements with the property owners and obtain necessary permits for obtaining suitable disposal locations and the Contractor shall

supply the Engineer with a copy of the written permission for such disposal from the property owner before any disposal may take place.

b. Low Hanging Branches. Low hanging branches and unsound or unsightly branches on trees and shrubs designated to remain shall be removed as directed. Branches of trees extending over the road surface shall be trimmed to give a clear height of 20 feet above the road surface. All trimming shall be done by skilled workmen in accordance with sound tree surgery practices and under the supervision of a licensed arborist. Cut or scarred surfaces of trees or shrubs shall be treated with an approved waterproof antiseptic tree paint.

c. Diseased Vegetation. All elm trees, trimmings, or branches of same or other wood designated by the Rhode Island Department of Environmental Management as a host of a serious plant disease or disease carrier, as indicated on the Plans, shall be buried at a sanitary landfill location within forty-eight hours after cutting.

Mechanical chipping of small branches and brush may also be employed where disposal area space limitations require such measures. The resulting chips need not be buried.

201.03.2 Cutting and Removing Isolated Trees and Stumps. The isolated trees and stumps to be removed will be designated on the Plans. Those so-designated shall be removed and disposed of by the Contractor in accordance with the provisions of **Subsection 201.03.1** of this Section.

201.03.3 Partial Removal of Isolated Tree Stumps. The isolated tree stump to be partially removed will be designated by the Engineer. Those so-designated shall be removed to 6 inches below final grade by the Contractor. The resulting hole shall then be filled in with like materials as required.

201.03.4 Frames, Covers or Grates shall be removed and either legally disposed of or stacked and stockpiled for subsequent re-use.

201.03.5 Culverts, Drainage and Utility Structures.

a. Culverts and Drainage Structures. Unless otherwise directed, the substructures of existing structures shall be removed down to the natural stream bottom and those parts outside of the stream shall be removed down one foot below natural ground surface. Where such portions of existing structures lie wholly or in part within the limits of a new structure, they shall be removed as necessary to accommodate the construction of the proposed structure.

b. Utility Structures. Sewer and utility structures which are designated to be removed or which interfere with the new construction shall be removed. When existing sewers or utilities are to be extended or otherwise incorporated into the new work, only such part of the existing lines shall be removed as to provide a proper connection with the new work.

c. Backfilling. No portions of the existing structures shall be used to backfill the excavations required for the removal of such structures. Excavations shall be backfilled with gravel borrow placed in 6-inch layers and compacted to 95 percent of maximum density in accordance with AASHTO T180.

d. Bridges. Bridges shall be removed as specified under **SECTION 803; REMOVAL OF EXISTING BRIDGES.**

201.03.6 Pipe. All pipe designated to be removed shall be so-removed and legally disposed of. The Contractor is allowed to dispose of concrete pipe in an embankment within the project limits, provided that the pipe is broken up into sufficiently small pieces to preclude the formation of voids.

201.03.7 Pavement, Sidewalks, and Curbing. All pavement, base course, sidewalks, curbs, gutters, of whatever nature designated to be removed shall be so-removed and legally disposed of.

When specified, ballast, gravel, bituminous material or other surfacing or pavement materials shall be removed and stockpiled as required. Otherwise such material shall be legally disposed of.

Where the remainder of the existing pavement or sidewalks are to remain undisturbed, a clean saw cut shall be made to separate the remaining pavement from that being removed.

201.03.8 Asbestos Cement Pipe.

a. Approved Disposal Sites. Asbestos cement pipe shall be removed and disposed of at landfill sites approved for such purpose by both the United States Environmental Protection Agency, and the Rhode Island Department of Environmental Management.

A partial list of sites which are believed to accept asbestos cement material for disposal is set forth in **Special Provision Code 201.1000** of the Contract.

Any disposal site chosen by the Contractor must have a license from the appropriate State and Federal agency to accept this material.

A copy of the license or approval must be given to the Resident Engineer. Said license must be valid at the time of disposal in the selected landfill.

The Contractor shall coordinate with the authorities in charge of the landfill for specific details on acceptability of the disposal of the asbestos-cement material.

b. Construction Methods (Removal and Disposal Procedures). Removal and disposal of asbestos cement pipe/duct bank, all types and sizes, shall be performed in the following manner:

1. The qualifications of personnel required for the removal and disposal operation must be approved by the Engineer.

2. Any required materials or equipment, such as; overalls, gloves, air respirator and etc. for persons involved in the handling of the AC material must meet the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) Standard 29 CFR 1926.

3. The Contractor will excavate the trench to the necessary width on either side and to the depth which will not exceed the bottom of the pipe while maintaining a safe angle of repose. The pipe should not be disturbed in any way during excavation. The AC material may have to

be wetted with water prior to breaking/cutting, depending on the requirements set forth by the selected landfill.

4. The asbestos landfill sites listed in the Special Provisions may have different restrictions on the length of the AC pipe/duct bank which they accept for disposal. If the Contractor chooses to break or cut the AC pipe/duct bank to meet the length requirement of the accepted landfill, it shall be done inside the trench area before the pipe is removed.

5. The AC pipe/duct bank shall be completely covered with a minimum 6-mil polyethylene sheet and/or bag fastened with high strength duct tape. The free ends of the sheeting or the end of the bag shall be folded outside and over the pipe/duct bank and be sealed transversely with the duct tape.

6. The polyethylene sealed asbestos cement pipe shall be lifted intact without additional breaking and placed in a transport vehicle (box type trailer) which completely contains the wrapped and sealed portion of pipe/duct bank on all sides. A box trailer with tarpaulin top is not acceptable.

7. Any remaining portions of AC material (i.e., pieces, fragments, collars, rubber gaskets, etc.) in the trench, overburden or work area, will be carefully collected and placed in a 6-mil polyethylene bag or sheeting. The bags or sheeted materials will be then placed in the manner of transport mentioned above. If the polyethylene bag or sheet is torn or punctured, the Contractor must repeat the above process to assure a sealed mode of handling at no additional cost to the Department.

8. All of the removal and placement of the AC material into the transport truck shall be accomplished with the Department's assigned Resident Engineer and/or designated representative present at the site.

9. The Contractor shall notify the Resident Engineer one week prior to the implementation of removal, disposal and transport operations.

10. No dumping of AC material will be permitted under any circumstances at any site except the approved asbestos landfill.

11. The Contractor shall also monitor the air quality based on the requirement as set forth by the U.S. Department of Labor, OSHA 29 CFR 1926.58(f).

201.03.9 Underground/Above-ground Storage Tanks.

a. Removal Procedures. The procedures for tank removal are briefly outlined below:

1. A permanent closure application must be submitted to the Department of Environmental Management, Division of Groundwater and Freshwater Wetlands at least ten days prior to the proposed closure.

2. The Contractor must confirm the closure with RIDEM, in full accordance with their regulations.

3. The Contractor must coordinate with the appropriate City of Town office to assure compliance with local requirements.

4. The tank must be purged and cleaned in accordance with RIDEM requirements.

5. The tank, all associated appurtenances, and any tank residue must be disposed of by a licensed hazardous waste hauler in accordance with all applicable laws and regulations.

6. All excavation and backfill will be in accordance with the applicable requirements of **Subsections 202.03.1** and **202.03.3; Excavation** and **Compaction**, respectively.

201.03.10 Removal of Fences, Railings, and Guardrail. All fences, railings and guardrail designated to be removed shall be so-removed and legally disposed of at an approved off-site location.

201.03.11 Removal of Miscellaneous Objects. All miscellaneous objects designated to be removed shall be so-removed and legally disposed of.

201.03.12 Demolition of Buildings and Structures.

a. General. All buildings and contents thereof shall become the property of the Contractor with the exception of materials or contents claimed by owners as part of land damage settlement or agreement with the State as indicated on the Plans. The State assumes no responsibility for said materials or contents.

Drain pipes or any other pipes, ducts, etc., disconnected and deemed advisable to remain in the earth shall be plugged with concrete, except that metal pipes may be capped with screw-type plugs or caps or otherwise sealed as directed by the Engineer. The Contractor shall cooperate with the City, Town and utility companies so that the demolition work may be performed in accordance with their regulations and with the approval of the Engineer.

If any concrete cesspools, septic tanks, galleys, or distribution boxes are present, they shall first be pumped out and then broken up into pieces sufficiently small to preclude the formation of voids. The resulting depression shall then be backfilled with common borrow and compacted, all to the satisfaction of the Engineer. Stone cesspools will be treated in a similar manner.

If steel septic tanks are present, the covers shall be removed and the interiors pumped out and subsequently completely filled with common borrow.

No building or structure shall be razed or demolished until the Contractor has made provision for proper rodent control in accordance with the requirements of the Town or City in which the work is being performed or as required by the Engineer.

b. Methods of Removal. The building to be demolished and disposed of shall be razed according to the most practical conventional method as approved by the Engineer. The Contractor shall take whatever precautions are necessary, and shall use sufficient water on non-salvable materials to prevent excessive spreading of dust during demolition operations. No blasting will be permitted unless authorized in writing by the Engineer and then only after the Contractor has received proper permission to do so from the appropriate State and/or local authority. For special provisions regarding the use of explosives, see **Subsection 107.10** of these Specifications.

Under no circumstances will burning be permitted.

The demolition work shall include the proper disposal of steps, building foundations, platforms, floors, cellar floors, walls, and any and all other parts of such building or structure and such outbuildings as may be indicated adjacent to or connected as a part of said building or structure. Debris of any nature shall not be allowed to accumulate in the streets, sidewalk areas or ground surrounding the demolition work. Upon completion of the work, the site shall be left in a clean and safe condition.

Concrete basement floors shall be broken up into segments no larger than 2-square yards each prior to filling. Basements or cavities left by structure removal shall be filled with common borrow to the level of the surrounding ground and, if within the highway prism of construction, shall be compacted in accordance with **Subsection 202.03.3; Compaction**, of these Specifications.

The Contractor shall shore up, brace, underpin, and protect all walls and other parts of existing structures adjacent to the demolition area which may be affected in any way by the demolition operations.

c. Disposal of Tanks. The disposal of storage tanks, including excavation and backfill and all other incidentals pertaining to this work, shall conform to the applicable requirements of **Subsection 201.03.9** of this Section.

d. Temporary Fencing. When cellar holes, pits or other hazardous depressions or excavations are adjacent to, or within the vicinity of a pedestrian access-way, a temporary guard fence shall be immediately erected for the protection of pedestrians. The fencing material shall be free from nails, fastenings or splinters, and shall present a reasonably smooth surface on the sides of possible contact. Such temporary fences shall be left in place and shall be properly maintained until their removal is authorized by the Engineer.

e. Watchman. The Contractor shall at all times provide a sufficient number of watchmen and guards as may be necessary, to properly safeguard the public from his operations. The Contractor will receive no extra compensation for such watchmen or guards.

201.04 METHOD OF MEASUREMENT. The several removal and disposal actions required to clear and prepare the site for construction will be measured for payment as follows:

201.04.1 Clearing and Grubbing. "Clearing and Grubbing" will be measured by the number of square yards, hundred square yards, or acres actually cleared and grubbed in accordance with the Plans and/or as directed by the Engineer.

201.04.2 Cutting and Removing Isolated Trees and Stumps. "Cutting and Removing Isolated Trees and Stumps" will be measured by the number of trees and stumps, or the number of stumps alone if there are no trees, actually cut and removed in accordance with the Plans and/or as directed by the Engineer.

201.04.3 Partial Removal of Isolated Tree Stumps. "Partial Removal of Isolated Tree Stumps" will be measured by the number of stumps actually removed in accordance with the Plans and/or as directed by the Engineer.

201.04.4 Removal of Frames, Covers or Grates. "Removal of Frames, Covers, or Grates" will be measured by the number of such units actually removed in accordance with the Plans and/or as directed by the Engineer.

201.04.5 Removal of Culverts, Drainage and Utility Structures. "Removal of Culverts, Drainage and Utility Structures" will be measured by the number of such structures actually removed in accordance with the Plans and/or as directed by the Engineer.

201.04.6 Removal of Pipe - All Sizes. "Removal of Pipe-All Sizes" will be measured by the number of linear feet of such pipe actually removed in accordance with the Plans and/or as directed by the Engineer.

201.04.7 Removal of Pavement, Sidewalks, and Curbing. "Removal of Pavement and Sidewalks" will be measured by the number of square yards of such pavement actually removed in accordance with the Plans and/or as directed by the Engineer. "Removal of Curbing" will be measured by the number of linear feet of such curbing actually removed in accordance with the Plans and/or as specified by the Engineer.

201.04.8 Removal of Asbestos Cement Pipe. "Removal of Asbestos Cement Pipe" will be measured by the number of linear feet of such pipe actually removed in accordance with the Plans and/or as directed by the Engineer.

201.04.9 Removal of Underground/Aboveground Storage Tanks. "Removal of Underground/Aboveground Storage Tanks" will be measured by the number of such tanks actually removed in accordance with the Plans and/or as directed by the Engineer.

201.04.10 Removal of Fences, Railings, and Guardrail. "Removal of Fences, Railings, and Guardrail" will be measured by the number of linear feet of such fencing actually removed in accordance with the Plans and/or as directed by the Engineer.

201.04.11 Removal of Miscellaneous Objects. "Removal of Miscellaneous Objects" will be measured by the number of such objects actually removed in accordance with the Plans and/or as directed by the Engineer.

201.04.12 Demolition of Buildings and Structures. "Demolition of Buildings and Structures" will be measured by the number of such buildings or structures actually demolished in accordance with the Plans and/or as directed by the Engineer.

201.05 BASIS OF PAYMENT. The several removal and disposal actions required to clear and prepare the site for construction will be paid for as follows:

201.05.1 Clearing and Grubbing. The accepted quantity of "Clearing and Grubbing" will be paid for at the contract unit price per square yard, hundred square yards, or acre as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, and equipment and for all other incidentals required to finish the work, complete and accepted by the Engineer.

201.05.2 Cutting and Removing Isolated Trees and Stumps. The accepted quantities of "Cutting and Removing Isolated Trees and Stumps" will be paid for at the respective contract unit prices per each as listed in the Proposal. The prices so-stated constitute full and complete

compensation for all labor, materials, and equipment and for all other incidentals required to finish the work, complete and accepted by the Engineer.

201.05.3 Partial Removal of Isolated Tree Stumps. The accepted quantity of "Partial Removal of Isolated Tree Stumps" will be paid for at the contract unit price per each as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, and equipment and for all other incidentals required to finish the work, complete and accepted by the Engineer.

201.05.4 Removal of Frames, Covers or Grates. The accepted quantities of "Removal of Frames, Covers or Grates" will be paid for at their respective contract unit prices per each as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, materials, and equipment and for all other incidentals required to finish the work, complete and accepted by the Engineer.

201.05.5 Removal of Culverts, Drainage and Utility Structures. The accepted quantities of "Removal of Culverts, Drainage and Utility Structures" will be paid for at their respective contract unit prices per each as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, materials, and equipment and for all other incidentals required to finish the work, complete and accepted by the Engineer.

201.05.6 Removal of Pipe - All Sizes. The accepted quantity of "Removal of Pipe-All Sizes" will be paid for at the contract unit price per linear feet as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, and equipment and for all other incidentals required to finish the work, complete and accepted by the Engineer.

201.05.7 Removal of Pavement, Sidewalks, and Curbing. The accepted quantities of "Removal of Pavement and Sidewalks" will be paid for at their respective contract unit prices per square yard as listed in the Proposal. The accepted quantities of "Removal of Curbing" will be paid for at the contract unit price per linear foot as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, materials, and equipment and for all other incidentals required to finish the work, complete and accepted by the Engineer.

Saw cutting associated with removal of pavement, sidewalks or curbing will be paid for separately under the appropriate work item(s) as listed in the Proposal.

201.05.8 Removal of Asbestos Cement Pipe. The accepted quantity of "Removal of Asbestos Cement Pipe" will be paid for at the contract unit price per linear foot as listed on the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, and equipment and for all other incidentals required to finish the work, complete and accepted by the Engineer.

201.05.9 Removal of Underground/Aboveground Storage Tanks. The accepted quantities of "Removal of Underground/Aboveground Storage Tanks" will be paid for at their respective contract unit prices per each as listed on the Proposal. The prices so-stated constitute full and complete compensation for all labor, materials, and equipment and for all other incidentals required to finish the work, complete and accepted by the Engineer.

201.05.10 Removal of Fences, Railings, and Guardrail. The accepted quantities of "Removal of Fences, Railings, and Guardrail" will be paid for at their respective contract unit prices per linear foot as listed in the Proposal. The prices so-stated constitute full and complete compensa-

tion for all labor, materials, and equipment and for all other incidentals required to finish the work, complete and accepted by the Engineer.

201.05.11 Removal of Miscellaneous Objects. The accepted quantities of "Removal of Miscellaneous Objects" will be paid for at their respective contract unit prices per each as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, materials, and equipment and for all other incidentals required to finish the work, complete and accepted by the Engineer.

201.05.12 Demolition of Buildings and Structures. The accepted quantities of "Demolition of Buildings and Structures" will be paid for at the respective contract unit price per each such building (or structure) as listed in the Proposal. The prices so-stated constitute full and complete compensation for demolition and removal, including disposal of surplus and waste materials, excavation, backfilling, rat eradication, pumping out, breaking up, and backfilling of cesspools and septic tanks; all expenses incidental to procurement of health, fire and police certificates; fencing and fence materials and watchmen or guards, clean-up, and all labor equipment, materials and incidentals necessary to finish the work, complete and accepted by the Engineer.

SECTION 202

EXCAVATION AND EMBANKMENT

202.01 DESCRIPTION. This work consists of excavation, and the satisfactory placement and compaction, or disposal, of all materials encountered within the limits of the work and which are necessary for the construction of the roadway. Excavation and embankment shall be in reasonably close conformity with the dimensions and sections indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

Excavation will be classified as "earth excavation," "rock excavation," "rock excavation - mechanical," "muck excavation," "channel excavation-earth," "channel excavation-rock," "channel excavation rock-mechanical," "loam excavation," and "unclassified excavation," all as hereafter described.

202.01.1 Earth Excavation. Earth excavation shall include the removal of suitable and unsuitable soils not otherwise classified herein, and the removal of boulders and rock fragments less than 1 cubic yard in volume, from the following areas:

a. Within the design excavation section.

b. Beyond the design excavation section of the roadbed or side slopes where unsuitable materials are encountered.

c. Beyond the design excavation section of shallow embankments when unsuitable materials are encountered.

202.01.2 Presplitting Bedrock. This work shall consist of producing a plane of split rock prior to any drilling or blasting for roadway rock excavation. This plane will be formed to follow the design of rock slope lines and shall be extended from the top of the bedrock surface to the

proposed rock shelf levels and to the toe of finished rock slope, to the invert of side drains, or to the depths specified on the Plans.

202.01.3 Rock Excavation. Rock excavation shall consist of the removal of intact bedrock, and boulders or detached bedrock fragments which have a volume of 1 cubic yard, or more. Boulders and detached rock fragments which have a volume of less than 1 cubic yard are considered "Earth Excavation."

202.01.4 Rock Excavation - Mechanical. This classification of rock excavation shall be employed in areas where blasting is prohibited. Rock excavated under this classification shall be removed by employing hydraulic splitters, air rams, paving breakers, or any other mechanical method approved by the Engineer.

202.01.5 Unsuitable Soils. Unsuitable soils shall include and are hereby defined as those soils, other than muck, which due to their consolidation properties, degree of saturation, gradation, or other deleterious characteristics will not provide a stable subgrade or side slopes; cannot be used as, or support embankment, or cannot be placed and compacted as backfill, or do not otherwise conform to the requirements of these Specifications.

202.01.6 Muck Excavation. Muck excavation shall consist of the removal and disposal of deposits of saturated or unsaturated mixtures of soils and organic matter not suitable for foundation material regardless of moisture content. The excavated muck shall be stockpiled at approved locations within the right-of-way and/or legally disposed of.

202.01.7 Channel Excavation Earth. Channel excavation earth shall include all materials other than water or "Channel Excavation Rock," removed from existing, new, or temporary water courses as indicated on the Plans or as directed by the Engineer.

202.01.8 Channel Excavation Rock. Channel excavation rock shall include intact bedrock and boulders 1 cubic yard or more in volume removed from existing, new, or temporary water courses, as indicated on the Plans or as directed by the Engineer.

202.01.9 Channel Excavation Rock - Mechanical. This classification of rock excavation shall be employed in channel construction areas where blasting is prohibited. Rock excavation under this classification shall be removed by employing hydraulic splitters, air rams, paving breakers, or any other mechanical method approved by the Engineer.

202.01.10 Loam Excavation. Loam excavation shall include loam or topsoil removed between the limits indicated and the depths specified on the Plans or directed by the Engineer. The excavated loam shall be stockpiled at approved locations within the right-of-way.

202.01.11 Unclassified Excavation. Unclassified excavation shall consist of the excavation, stockpiling and/or removal and legal disposal of a composite mixture of various types of materials which the Engineer has determined to be impractical to segregate into separate classifications.

202.01.12 Embankment Construction. Embankment construction shall consist of constructing roadway embankments, including preparation of the areas upon which they are to be placed; the benching of embankments; the construction of side slopes and toe drainage ditches; the construction of dikes within or outside the right-of-way; the placing and compacting of approved material within roadway areas where unsuitable material has been removed; and the placing and

compacting of embankment material in holes, pits and other depressions within the roadway area. Only approved materials shall be used in the construction of embankments and backfills.

202.02 MATERIALS.

202.02.1 Common Borrow. Common borrow shall consist of approved material required for the construction of embankments or for other portions of the work. Common Borrow shall be obtained from approved sources and shall meet the requirements of **Subsection M.01.01** of these Specifications.

202.02.2 Gravel Borrow. Gravel borrow shall meet the requirements of **Subsection M.01.09; Gradation of Aggregates, Table I, Column I**.

202.03 CONSTRUCTION METHODS.

202.03.1 Excavation-General. The Contractor shall remove all soil, rock, and other material and utilize or dispose of these materials as required by the Plans and these Specifications. The excavation for the roadway, intersections and entrances shall be finished to reasonably smooth and uniform surfaces. All rock cuts shall be thoroughly cleaned and scaled of all loose fragments. No materials shall be wasted without permission of the Engineer. Excavation operations shall be conducted so that material outside of the limits of slopes will not be disturbed. Prior to beginning excavation operations in any area, all necessary work in that area shall have been performed in accordance with **SECTION 201; SITE PREPARATION**, and all erosion and pollution controls shall have been installed in accordance with the applicable requirements of **SECTIONS 206 through 211** of these Specifications.

The Contractor shall maintain slopes, crowns, berms, and ditches on all excavations to insure satisfactory drainage at all times to protect the work, and maintain safe working conditions.

When the Contractor's excavating operations encounter remains or artifacts of potential historical or archaeological significance, the operations shall be temporarily discontinued. The Contractor will immediately contact the Engineer who will determine the disposition thereof. When directed by the Engineer, the Contractor shall excavate the site in such a manner as to preserve the artifacts encountered and shall remove them for delivery to the custody of the proper State authorities. Such excavation will be considered and paid for as Extra Work in accordance with **Subsection 104.05** of these Specifications.

a. Rock Excavation-General. Should bedrock be encountered above the design finish grade, the Contractor shall immediately notify the Engineer of the change in classification. The Contractor shall then continue soil excavation to expose the bedrock surface and to allow the Engineer to perform the necessary elevation survey and take cross-sectional measurements.

Prior to removal of overburden, or presplitting and blasting to excavate to the design rock slope face, the Contractor shall locate the presplit line, and the intersection of the crest of the design slope with existing ground surface. Elevations of existing ground surface along this intersection alignment shall be established at one-half station intervals or as directed by the Engineer. The Contractor shall install marker stakes at the directed station intervals, offset as directed by the Engineer.

Rock Excavation may be performed by blasting, where not prohibited, or by mechanical methods. However, where blasting is allowed, whatever the method used, bedrock removal shall be classified, measured and paid for as Rock Excavation.

The Contractor shall be required to submit a Blasting Plan prior to the performance of any drilling or blasting. The Plan shall include as a minimum: full details of drilling and blasting patterns and techniques proposed for controlled and production blasting. The blasting plan is for quality control and record keeping purposes. Review of the blasting plan does not relieve the Contractor of the responsibility to use existing drilling and blasting technology and for obtaining the desired results.

The Contractor shall be required to employ a qualified blasting supervisor, with presplitting experience acceptable to the Engineer. This supervisor shall be available, as required, throughout the duration of presplitting and fragmentation blasting rock excavation.

Unless otherwise specified, material classified as rock shall be excavated to a minimum depth of 12 inches below subgrade within the limits of the roadbed, and the excavation backfilled with material as designated on the Plans or approved by the Engineer.

Rock removal in excess of 12 inches below subgrade will not be paid for, but will be measured by the Engineer to determine excess backfill volume, said volume to be deducted from that backfill measured for payment. All backfilling in excess of the 12-inch depth shall be performed at the expense of the Contractor.

1. Rock Excavation-Presplitting. When required, the Contractor shall presplit the rock along the designated cut face to produce a uniform plane of rupture, so that the resulting face will not be affected by subsequent fragmentation blasting and excavation operations, all in accordance with the limits designated or indicated on the Plans.

Presplitting shall be used whenever the intended exposed rock slope exceeds 10 feet in vertical height. Rock cuts more than 25 feet in vertical height may be presplit in stages (lifts) at the option of the Contractor, provided, however, that no stage shall be less than 10 feet in depth, and further provided that no payment will be made for additional excavation quantities caused by the offsetting of presplitting holes beyond the specified face in the top or successive stages. Presplitting holes in successive stages shall be offset not more than 2 feet inside of the previously presplit stage face.

When drilling and blasting behind existing previously drilled and blasted rock faces to widen the rock cut, the Contractor shall presplit along the new design rock face alignment and exercise all due care to prevent overblasting of the new rock face. If after excavating the blasted rock, it is not possible to hold a true and neat face-of-rock, then the Contractor will excavate all loose and unstable, fractured or seamed rock to an agreed stable face of rock behind the neat lines as ordered by the Engineer.

The drilled presplitting holes shall follow the required rock slope lines and inclinations. Unless otherwise permitted by the Engineer, presplitting holes shall have a maximum spacing of 3 feet, center-to-center, and a diameter not greater than 3 inches.

Presplitting holes shall be extended from the top of solid bedrock surface to 2 feet below the design toe of finished bedrock slope, unless different depths are specified on the Plans. The proper angle of drilling shall be maintained at all times so that all presplit holes lie essentially in

the same plane and are parallel to each other. No hole shall deviate more than one half-foot at any place in the plane of the specified slope line, nor in its vertical alignment.

2. Rock Excavation-Fragmentation Blasting. The Contractor shall adjust his blasting operations according to the characteristics and structure of the rock formation to obtain the required slope without fracturing rock beyond the presplit face.

(a) Fragmentation blast holes shall be positioned so that:

- No portion of any blast hole 3 inches or less in diameter shall be within 4 feet of the designated presplit face.

- No portion of any blast hole greater than 3 inches in diameter shall be within 12 feet of the designated presplit face.

(b) The Contractor shall inspect and test each hole for its entire depth to determine the possible presence of any obstruction prior to placing the charge. No loading shall be permitted until the hole is clear of all obstructions for its entire depth. All necessary precautions shall be used in placing the charge to prevent cave-in of material along the sidewall of the hole.

All space in each hole not occupied by the explosive charge shall be filled with 3/8-inch size clean stone chips. No other material or type of stemming will be permitted.

(c) Blasting for presplitting shall precede fragmentation blasting.

(d) Remove the blast rock and expose the presplit face such that the surfaces of slopes in rock cuts are free from all loose stone or shattered edges.

All unsuitable material, breakage, and slides, even though located beyond the payment lines, shall be removed as directed.

b. Excavation of Unsuitable Materials. Where unsuitable soils are encountered within the excavated section and above the design finish grade, excavation shall be suspended to allow area measurements and survey of elevations across the exposed surface. Excavation of unsuitable soils shall then proceed until either a change of excavation classification occurs, or until the excavation reaches a stable base or as otherwise directed by the Engineer. If a change in classification occurs, a second set of surveyed elevations shall be obtained. The Engineer shall determine the required transverse spacing and station intervals of survey points.

Where excavation to the designed subgrade elevation results in a subgrade or slopes of unsuitable soil, the Engineer shall require the Contractor to remove the unsuitable materials and backfill and compact to the designed subgrade elevation with approved material. The Contractor shall conduct his operations in such a way that the Engineer can take the necessary cross-sectional measurements before the backfill is placed.

Material designated as unsuitable shall be legally disposed of at no additional cost to the State.

Prior to placing of any subbase, base or pavement courses, all surplus excavated material including stumps, earth, rock, etc., shall be removed and the shoulders, ditches and slopes graded to approximate final lines.

c. Muck Excavation. If the unsuitable material involved is muck, the excavation will be accomplished without entrapping muck within the backfill. The backfilling of the excavation area shall proceed immediately behind the muck excavation so material that is displaced by the backfill can be removed. The excavation will be backfilled to the ground level or 3 feet above water level, whichever is higher, with rock or other suitable granular material selected from the roadway excavation. If suitable material is not available from the excavation, it will be obtained from other approved sources.

d. Haulage. Compensation for haulage of earthwork materials within the project limits shall not be paid for separately, but shall be deemed to be included in the contract unit prices for the respective items.

202.03.2 Embankment Construction-General. Embankment construction for roadways and associated ramps, dikes, and berms shall consist of the placement and compaction of suitable earth and rock excavation materials, or borrow material, as required. Construction of embankment may continue during cold weather, however, frozen soils shall be removed and shall not be permitted as fill for embankment. Rocks, broken concrete, or other solid materials shall not be placed in embankment areas where piling, guardrail, electrical poles, conduits, etc., are to be driven or placed.

a. Preparation of Foundation. After cleaning and removal of topsoil where necessary, the Contractor shall notify the Engineer and prepare the embankment foundation as follows:

1. Where embankment will be greater than 4 feet in height above existing ground, the Engineer shall determine whether preparation of the foundation will be necessary.

2. For embankment less than 4 feet in height above existing ground, completely break up the cleared ground surface to a minimum depth of 6 inches by plowing or scarifying. Compact the existing ground surface in accordance with **Subsection 202.03.3.**

3. Where unsuitable soils occur at existing ground surface, excavate and replace unsuitable soils with excavation or approved borrow material and compact in accordance with the applicable provisions of **Subsection 202.03.3.**

4. Where embankment is less than 2 feet in height above an existing road surface, scarify or pulverize the existing roadway to a depth of 6 inches below the pavement surface. Reduce all particles to a maximum size of 6 inches and produce a uniform material. Compact the roadway surface in accordance with the applicable provisions of **Subsection 202.03.3.**

b. Roadway Embankment-Earth. Roadway embankments may consist of earth excavation, common borrow, gravel borrow, or a combination thereof. Unless the Department mandates the sequencing of materials in the embankment, borrow material shall not be placed until all suitable and accessible materials from all structure, trench, and roadway excavations have been placed. If the Contractor places more borrow than is required and thereby causes a waste of excavation, the amount of such waste will be deducted from the borrow volume as measured.

When borrow material is required to construct embankment, the Contractor shall make his own arrangements to procure the borrow or open a borrow source. The Contractor shall also determine the suitability of the borrow material for use in embankment by appropriate laboratory testing.

Roadway earth embankments shall be placed in horizontal layers not exceeding 12 inches (after compaction) and shall be compacted as specified in **Subsection 202.03.3** before the next layer is placed.

All earth embankment material shall be placed to the full width unless otherwise directed.

The entire area of each layer shall be uniformly compacted to at least the required minimum density by use of compaction equipment consisting of rollers, compactors or a combination thereof. Earth-moving and other equipment not specifically manufactured for compaction purposes shall not be considered as compaction equipment.

As the compaction of each layer progresses, continuous leveling and manipulating will be required to attain uniform density. Water shall be added or removed, if necessary, in order to obtain the required density. Construction equipment shall be routed uniformly over the entire surface of each layer.

If the natural-in-place moisture of the excavated material makes it impractical to compact the soil, the Contractor shall dry the soil by disking, harrowing, blading or other approved means. If these methods do not produce the specified compaction, the Contractor shall strip and replace the soil.

The embankment shall be crowned to shed runoff and constructed such that side slopes are protected from erosion.

c. Roadway Embankment-Rock. Rock fragments or boulders to be used in the construction of embankments shall be reduced to segments with the maximum dimension not exceeding 36 inches. The rock fragments and boulders shall be so shaped and proportioned that they can be effectively bedded in the top of the existing ground surface or the preceding embankment layer. The rock fragments and boulders must be fully embedded in the placement layer which is not to exceed 3 feet in depth.

Each rock fill layer shall be compacted using suitable equipment as described in **Subsection 202.03.3; Para. a**.

Individual boulders may be placed in embankment. However, boulders shall not be nested, and the Contractor shall use appropriate methods and equipment as required to satisfactorily embed boulders in soil lifts and to compact adjacent fill.

Each layer shall be leveled with suitable equipment and the interstices filled with finer fragments and earth. The rock lifts shall not be constructed above an elevation 2 feet below the finished subgrade. The balance of the embankment shall be composed of suitable material compacted as specified herein.

d. Excess Materials. All excess or unsuitable excavated material, including rock and boulders, that cannot be used in embankments may be placed in a satisfactory manner on the side slopes of the nearest fill. In case it is impossible to dispose of all such material in the manner described above, the remainder shall be legally disposed of by the Contractor at no additional cost to the State.

e. Benching Existing Embankments. When embankment is to be placed and compacted against either an existing embankment or slope steeper than 4-to-1, horizontal benches shall be cut into the existing slopes to a sufficient width to accommodate placing and compaction operations and equipment. The Contractor shall bench the slope as each embankment layer is placed and compacted. Each bench shall begin at the intersection of the original ground and the vertical cut of the previous bench.

Benches may be cut to a maximum height of 3 feet. Embankment layers shall be placed and compacted in accordance with the applicable provisions of **Subsection 202.03.3**. There will be no separate payment for providing benches other than under the appropriate excavation classification.

f. Embankment Against Structures. If embankment can be deposited on one side only of abutments, wing walls, piers or culvert headwalls, care shall be taken that the area immediately adjacent to the structure is not compacted to the extent that it will cause overturning of or excessive pressure against the structure. When noted on the Plans, the fill adjacent to the abutment of a bridge shall not be placed higher than the bottom of the backwall of the abutment until the superstructure is in place. When embankment is to be placed on both sides of a concrete wall or box type structure, operations shall be so conducted that the embankment is always at approximately the same elevation on both sides of the structure. In addition to these requirements, refer to **Subsection 203.03.5; Backfilling**, of these Specifications.

g. Embankment Below Prevailing Water Level. Backfilling and compacting excavated muck areas below prevailing water level may be accomplished as directed by the Engineer until the excavated area is backfilled to an initial loose state level not more than 3 feet above the prevailing water level.

Embankments to an elevation 3 feet above the free water surface at the time of filling shall be constructed of rock, or a free-draining granular material as approved by the Engineer.

Where filling in 12-inch layers is impracticable as may be the case of filling in water, the Engineer may allow embankment to be constructed in one layer to the minimum elevation at which equipment can be operated. Above this elevation, the embankment shall be constructed as specified in **Subsections 202.03.2b and 202.03.3.**

h. Drainage Extension Embankment Detail. On projects which call for the extension of existing drainage lines in excavation and embankment areas, the Contractor shall maintain the flow of water throughout the construction process. In such cases, the following method of construction shall apply up to a minimum height of 3 feet above the outside diameter of the pipe:

1. Embankment will be constructed to an elevation equal to the invert elevation.

2. Trench excavation will be performed in the compacted embankment for the placing of pipe bedding. The width of trench excavation will be governed by the dimensions specified in **SECTION 205; TRENCH EXCAVATION.**

3. A layer of bedding material will be placed against the outside of the pipe, its width governed by the horizontal pay limits of trench excavation. Outside of these limits common

borrow will be placed. Each fill layer will not exceed a thickness of 8 inches, measured after compaction.

4. The bedding material will extend to the height specified under **SECTION 701; CULVERTS AND STORM DRAINS.**

202.03.3 Compaction-General. Each layer shall be uniformly compacted to the specified density before the next layer is placed. The specified density shall be obtained by utilizing any approved compaction equipment such as: pneumatic tired compaction equipment, or three-wheeled power rollers, or vibratory, sheepsfoot, or tamping rollers, or other approved types of compaction equipment.

Dumping and rolling areas shall be kept separate, and no lift shall be covered by another until the compaction requirements of this Subsection have been met. Hauling and leveling equipment shall be routed and distributed over each layer of the fill so as to make best use of that compaction effort.

a. Densities.

1. Maximum density will be determined by AASHTO T180.

2. Field density of soil in place shall be determined by either AASHTO T191 or a nuclear moisture density gauge conforming to AASHTO T238 and T239.

3. The method of correcting for oversize particles in soil compaction test results shall conform to AASHTO T224.

b. Compaction of Earth Embankment.

1. Subgrade. The resulting subgrade surface shall be compacted as required, to not less than 95 percent of maximum density, measured to a depth of 12 inches below the surface.

2. Embankment Sections. Earth in embankment sections below a plane of three feet below subgrade shall be compacted to not less than 90 percent of maximum density. The remainder of the roadway section up to subgrade shall be compacted to 95 percent of maximum density.

c. Compaction of Rock Embankment. Rock fill layers shall be sized, placed, and choked as described in **Subsection 202.03.2; Para. c.**

202.04 METHOD OF MEASUREMENT.

202.04.1 Excavation-General. The types of excavation specified in this Section will be measured on a volume basis as computed from the area in its original position. The volume will be determined by differencing the area to be excavated from its original position before excavation is begun to the design subgrade after excavation is completed. Differencing will be accomplished by taking cross sections at intervals stated herein by standard field survey techniques. Two sets of cross sections will be taken over the area to be excavated; one set of

the area in its original position and a final set after completion of excavation. (Intermediate sets of cross sections may be authorized for progress payment purposes).

Should the final set of cross sections indicate unauthorized excavation below the design subgrade, the excess excavation shall not be measured for payment. However, the excess excavation shall be replaced by available suitable excavation or borrow material, all provided, placed and compacted at no cost to the State.

The final set of cross sections may include an amount for overbreakage or slides, as subsequently defined, which in the judgment of the Engineer were not caused by any carelessness on the part of the Contractor.

The cross sections will then be plotted and the volume determined by either the average end-area method or such other equivalent method acceptable to the Engineer.

a. Earth Excavation. Earth excavation shall be measured by the cubic yard as calculated by differencing the area excavated from its original position before earth excavation is begun to its position when:

1. There has occurred a change in classification of excavation; or

2. The design subgrade elevation has been reached; or

3. The approved limits of excavation of unsuitable soils below design subgrade elevation or behind design side slopes are reached; or

4. The approved limits of excavation of unsuitable soils under shallow embankment have been reached.

Area differencing shall be conducted by taking cross sections as described above in this **Subsection 202.04.1.**

b. Presplit Bedrock. Presplitting of bedrock shall be measured by the number of square yards of area of presplit rock face along the alignment at the inclination designated on the Plans. This area shall be measured and calculated as follows:

At one-half station locations, the distance from the top of the presplit face to the toe of the presplit face, including toe drain, shall be measured using a steel tape held taut and against the top and toe of slope. One-half station areas shall be calculated by multiplying the average of adjacent one-half station measurements by a one-half station horizontal distance. The total measurement for presplitting will be calculated by summing the one-half station areas.

c. Rock Excavation and Rock Excavation - Mechanical. When rock surface occurs above the design grade of bottom of excavation, the Contractor shall immediately notify the Engineer so that determinations of the initial surface elevation and area of rock exposure can be made for preparation of cross sections for measurement for payment. Cross sections for rock excavation measurement shall be prepared at maximum spacing of one-half stations (50 feet). At the completion of rock excavation and clearing of loose fragments, a second set of elevations shall be determined for the excavated and cleared rock surface.

The volume of rock excavation and rock excavation-mechanical to be measured for payment shall be calculated from the difference between the cross-sectional surface elevations, using the average end-area method or such other equivalent method acceptable to the Engineer.

Volume calculated for payment shall include overbreakage of up to 12 inches below the design bottom of excavation in rock as described in **Subsection 202.03.1; Para. a.** Should the cross sections indicate bottom overbreakage and excavation in excess of the 12-inch allowance, the Contractor shall not be paid for rock excavation in excess of the overbreakage allowance. However, he shall provide, place, and compact fill and/or borrow required to replace the excess overbreakage at no cost to the State.

Except for presplit areas, measurement for payment for rock excavation or rock excavation-mechanical shall include an allowance for overbreakage along rock side slopes to an amount not to exceed, in any half-station of 50 feet, 10 percent of the actual quantity of rock excavation measured and calculated for that half-station. Rock side slope overbreakage in excess of the allowance will not be included for payment and shall be removed by the Contractor at no cost to the State.

This **Subsection 202.04.1; Para. c** also applies to Channel Rock Excavation and Channel Rock Excavation-Mechanical.

Rock Excavation in presplit areas shall be measured to the presplit face or design limits, whichever is less. Overbreakage from blasting will not be measured for payment but shall be removed as directed at no additional cost to the State.

202.04.2 Embankments. When the Contract specifically provides for payment for embankments, or when embankments are constructed with material obtained from sources other than excavation, embankment will be measured by the number of cubic yards of material actually placed and compacted within the limits of the design embankment section. The in-place volume will be calculated by differencing cross sections taken along the original ground from those taken along the top of the completed embankment. The two sets of cross sections will then be plotted and the volume determined by either the average end-area method or such other equivalent method approved by the Engineer.

All boulders and detached stones which have a volume in excess of 1 cubic yard and which the Contractor desires to incorporate into embankment construction must first be broken up into fragments whose respective volumes are 1 cubic yard or less. There will be no additional payment for breaking up such boulders and stones.

When the Contract does not specifically provide for payment for embankment, or when embankments are constructed with material obtained solely from excavation, the work of embankment construction will not be measured or paid for separately, but will be considered incidental to the various classifications of excavation.

However, when embankment is constructed from excavation material and there is required borrow material to complete the embankment, this borrow material shall be measured for payment.

Appurtenances, structures, pipes and drainage structures less than 50 cubic yards in volume shall not be deducted from embankment volumes for measurement of embankment or measurement of borrow for embankment.

202.04.3 Measurement of Borrow. Common Borrow, Gravel Borrow, or other borrow approved for use to replace unsuitable materials removed by excavation, or to construct embankment, shall be measured by the cubic yard as in-place and compacted. This volume shall be determined by area differencing using cross sections as described in **Subsection 202.04.1; Excavation-General.**

202.05 BASIS OF PAYMENT.

202.05.1 Excavation. The accepted quantities of "Earth Excavation," "Rock Excavation," "Rock Excavation - Mechanical," "Muck Excavation," "Channel Excavation - Earth," "Channel Excavation - Rock," " Channel Excavation - Rock Mechanical," "Loam Excavation," and "Unclassified Excavation" will be paid for at their respective contract unit prices per cubic yard as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, materials, and equipment, including excavation within the prescribed limits of the work, formation of embankments, grading, compaction, disposal of surplus materials, preparation of subgrade and shoulders, and all other incidentals required to finish the work, complete and accepted by the Engineer.

202.05.2 Presplitting Bedrock. The accepted quantity of "Presplitting Bedrock" will be paid for at the contract unit price per square yard as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, and equipment and all other incidentals required to finish the work, complete and accepted by the Engineer.

202.05.3 Borrow. If specifically called for in the Contract for embankment construction, or if approved for replacement of unsuitable soils in excavation or under shallow embankment, "Common Borrow" and/or "Gravel Borrow" will be paid for at their respective contract unit prices per cubic yard as listed in the Proposal. The prices so-stated constitute full and complete compensation for all fees, leases, permits, and equipment, labor, and operating costs associated with procuring, clearing, working, and restoring a borrow pit; all labor, materials, and equipment, hauling, formation of embankments, grading, compaction, disposal of surplus materials, preparation of subgrade and shoulders; and all other incidentals required to finish the work, complete and accepted by the Engineer.

SECTION 203

STRUCTURE EXCAVATION AND BACKFILL

203.01 DESCRIPTION. This work consists of the removal and disposal of all material of whatever nature necessary for the construction of all structures and incidental foundations not included elsewhere in these Specifications. The work includes preserving channels, shoring and bracing, constructing cofferdams, sealing foundations, dewatering, excavating, preparing foundations, backfilling, and subsequent removal of safety features and cofferdams. Finally, this work shall include all necessary on-site or borrow backfill, as hereinafter specified.

The material to be excavated is that which is included within the pay lines indicated on the Plans and as hereinafter defined, and which is not otherwise classified in either **SECTION 202; EARTHWORK AND EMBANKMENT** or **SECTION 205; TRENCH EXCAVATION**.

Structure Excavation and Backfill will be subdivided into the following six classifications:

203.01.1. Structure Excavation; Earth. Structure excavation; earth shall include all excavation not classified as rock, rock-mechanical, masonry, or unclassified excavation.

203.01.2 Structure Excavation; Rock. Structure excavation; rock shall include the removal of bedrock or boulders and detached bedrock fragments over 1 cubic yard in volume when encountered within the limits of Structure Excavation. Boulder and rock fragments less than 1 cubic yard volume are considered Structure Excavation; Earth.

203.01.3 Structure Excavation; Rock - Mechanical. This classification of structure excavation - rock shall be employed in areas where blasting is prohibited. Rock excavated under this classification shall be removed by employing hydraulic splitters, air rams, paving breakers, or any other mechanical methods approved by the Engineer.

203.01.4 Structure Excavation; Masonry. Masonry excavation shall include the removal of all concrete or stone masonry built either with or without mortar (includes incidental structures in excess of 1 cubic yard) wherever they are encountered within the limits of Structure Excavation, provided that such masonry has not been included under any applicable provision of **SECTION 201; SITE PREPARATION**, of these Specifications.

203.01.5 Unclassified Structure Excavation. Unclassified structure excavation shall include the removal and disposal of that composite mixture of various types of materials for which the Engineer determines it is impractical to classify into separate classifications for payment, and which is encountered within the designated pay lines.

203.01.6 Crushed Stone Fill Under Structures. This work shall consist of providing one or more courses of crushed stone fill and filter fabric under structures' footings on prepared subgrade surfaces in reasonably close conformity with the lines, grades, thickness and typical cross sections indicated on the Plans.

203.02 MATERIALS. Backfill materials as specified in the Contract Documents shall conform to the applicable requirements of **SECTION M.01; BORROW AND AGGREGATES,** of these Specifications.

203.02.1 Crushed Stone Fill Under Structures. Crushed stone shall conform to the gradation requirements of **Subsection M.01.09, Table I, Column II** of these Specifications. Filter fabric shall be one of those materials included on the Department's Approved Materials List.

203.02.2 Cofferdams. The requirements for structural materials for cofferdams such as tremie concrete, steel sheet piling, and steel bracing will be provided in the Special Provisions of the Contract.

203.03 CONSTRUCTION METHODS.

203.03.1 Excavation.

a. Notification. The Contractor shall notify the Engineer sufficiently in advance of the beginning of excavation, and immediately when it believes there is a change in classification of structure excavation, in order that cross-sectional elevations and measurements may be taken of the undisturbed ground.

b. Dimensions of Excavation. The excavation for footings shall be of sufficient size to accommodate both the placement of the structure as indicated on the Plans and the placement and compaction of backfill. Excavation shall extend at least 2 feet horizontally beyond the vertical face of footings, and a minimum of 12 inches below the base of footings.

c. Change in Elevation or Dimension of Excavation. The elevation of the bottoms of excavations shall be as indicated on the Plans. However, the Engineer may direct the Contractor to make such changes in the elevation or dimensions of the excavation as may be necessary to secure a satisfactory foundation.

Whenever such additional work as described above effects changes in quantities involving items designated in the Contract, the provisions relating to such items as specified under **SECTION 104; SCOPE OF WORK**, will apply.

d. Approval of Foundation. No formwork or permanent work shall commence until after the Engineer has approved the depth and dimensions of the excavation, the character of the material and the condition of the foundation. Sounding rods shall be driven at such points and to such depths as may be directed by the Engineer.

The Contractor shall provide assistance to the Engineer as may be necessary to make an adequate inspection of the foundation material. No extra compensation will be allowed for providing this assistance.

All unsheathed excavation shall have sufficient side slopes to prevent earth sliding in on the work.

e. Utilization of Excavated Materials. All suitable excavated material shall be utilized as backfill or in embankments. Surplus excavation or unsuitable materials may be either disposed of in non-critical areas within the project limits or legally disposed of.

f. Blasting. All blasting in connection with rock excavation within project limits shall be completed before the placing of any structure concrete unless an exception is granted by the Engineer in writing.

g. Alternatives & Unsatisfactory Bearing Surfaces. Whenever in the opinion of the Engineer the natural foundation material is inadequate to safely support the structure, the Contractor shall proceed with alternative methods as directed by the Engineer. Where not otherwise listed in the Proposal, such operations shall be considered "Extra Work," and paid for in accordance with **Subsection 104.05** of these Specifications.

h. Water. When water is encountered, provisions shall be made for draining or dewatering within the excavation. The dewatering work shall be accomplished by means that will

prevent disturbing the bottoms of excavations or adjacent structures. When foundation material is relatively impermeable, such that water accumulations tend to soften the cementing material or puddle the surface, provisions shall be made to drain the excavation by suitable channels outside of, and slightly below, the footing level. These channels shall conduct the water to outfalls or sump pumps. Foundation material unduly disturbed or softened by the use of equipment or by inadequate handling of water shall be removed and replaced with material satisfactory to the Engineer and at the Contractor's expense.

i. Preparation of Bearing Surface. All rock or other hard foundation material shall be freed from all loose material, cleaned and cut to a firm surface, either level, stepped or serrated as directed by the Engineer. All seams shall be properly cleaned out and filled with concrete mortar or grout. All shaping of ledge rock shall be carefully executed to avoid any unnecessary excavation of sound rock. No payment for overbreak will be allowed except as provided under **Subsection 203.04; Method of Measurement**.

203.03.2 Cofferdams. Cofferdams shall be utilized when the bottoms of excavation are below the prevailing water surface. Cofferdams, when specified or required in order to dewater such excavations, shall consist of timber, steel sheet piling, cylindrical metal shells or other structural components. Earthen embankments and dikes will not be classified as cofferdams.

a. Shop Drawings. For substructure work, the Contractor shall submit drawings showing his proposed method of cofferdam construction and other details left open to his choice or not fully shown on the Plans. Such drawings shall be approved by the Engineer before construction is started, but such approval shall not in any way relieve the Contractor of his responsibility under the Contract, to secure a safe and satisfactory cofferdam. Shop drawings shall be prepared and submitted in accordance with **Subsection 105.02; Plans and Shop Drawings,** of these Specifications.

b. Construction. Cofferdams for foundation construction shall, in general, be well braced and as watertight as practicable. The interior dimensions of cofferdams shall be such as to give sufficient clearance for the construction of forms and the inspection of their exteriors, and to permit dewatering outside of the forms. Where piles are required, the cofferdam shall be of sufficient size to permit the driving of the piles in the exact positions shown on the Plans without interference from the wales or bracing or requiring excessive rebracing. Cofferdams which are tilted or moved laterally during the process of installation shall be righted, reset or enlarged to provide the necessary clearance. These corrective measures shall be made at the sole expense of the Contractor.

Cofferdams shall be constructed and dewatered to protect green concrete against damage from water and to prevent damage to the foundation by erosion.

No construction materials shall be left in cofferdams in such a way as to extend into the substructure masonry.

c. Tremie Seal. Cofferdams shall be dewatered and the foundations shall be placed in the dry. Well point systems and methods will be approved at suitable locations, if required. However, when conditions are anticipated which would render it impractical to dewater the cofferdam before placing masonry, a tremie seal shall be placed both in accordance with **Subsection 808.03.5; Para. f** of these Specifications, and to the dimensions shown on the Plans.

During the placing of a tremie seal and until the seal has set, the elevation of the water inside the cofferdam shall be controlled to prevent any flow through the seal.

Pumping to dewater a sealed cofferdam of the gravity type shall not commence until the concrete seal has been in place for at least 3 days for spread footing foundations, and at least 7 days for pile-supported foundations.

After dewatering, the balance of the foundations shall be placed in the dry, with such modifications as may be necessary for structural purposes.

d. Removal of Cofferdams. Unless otherwise provided, cofferdams including all sheeting and bracing, shall be removed by the Contractor as directed by the Engineer. The removal operation shall be effected in such manner to not disturb or otherwise damage the work. The Contractor shall not remove cofferdams without prior notification and approval of the Engineer.

If the cofferdam is to remain in place, it shall be vented or ported below low water level when dewatering is no longer necessary.

203.03.3 Dewatering. Dewatering from the interior of any foundation enclosure shall be carried out in such manner as to preclude the possibility of movement of water through any fresh concrete. No pumping will be permitted during the placing of concrete or for a period of at least 24 hours thereafter, unless it be done from a suitable sump separated from the concrete work by a mortar-tight form, bulkhead, or other effective means.

203.03.4 Embankments Under Structure Foundations. Embankments under stub abutments, walls, culverts, footings, and other foundations where stability requirements are essential shall be constructed of gravel borrow conforming to **Subsection M.01.09, Table I, Column I,** except that the material shall not contain particles greater than 6 inches maximum dimension.

Embankments shall be constructed such that side slopes are sufficiently stable, and such that the widths of embankments shall extend horizontally 2 feet beyond the vertical faces of footings. The gravel borrow shall be placed in layers not exceeding 12 inches in depth before compaction and shall be compacted to 95 percent of maximum density as determined by AASHTO T180.

Embankments under pile supported foundations shall be compacted to 90 percent of maximum density as determined by AASHTO T180.

203.03.5 Backfilling.

a. Protection of Structures During Backfilling. No fill material shall be placed against any structure until permission to place fill has been granted by the Engineer and in no case until the masonry has obtained the 28-day compressive strength or unless otherwise specified in the Special Provisions.

In all cases proper precautions shall be taken to assure that the method of backfilling does not cause movement of or undue strain on any part of the structure. Fill material shall be deposited and compacted behind abutments, walls and miscellaneous structures as hereinbefore specified. Special precautions shall be taken when placing fill around slender foundations, rigid frame legs, piers or over and around arches and box culverts, to deposit the

material on both sides of such structures to approximately the same elevation at the same time.

Backfill materials shall be carefully placed to avoid damage to masonry and waterproofing treatments. If backfilling or other operations do in fact damage masonry or waterproofing, the Contractor shall remove the backfill and replace or repair the damaged work or waterproofing at the direction of the Engineer. All such repairs, replacement of materials, and labor shall be provided at no additional cost to the State.

b. Pervious Fill Adjacent to Structures. The material placed adjacent to, or in contact with arches, culverts, retaining walls, wingwalls, secondary structures, and other areas indicated on the Plans shall be pervious fill.

Pervious fill shall be placed in layers not over 12 inches in depth before compaction and shall be compacted to 95 percent of maximum density as determined by AASHTO T180. In those locations not accessible for normal placing and rolling and for minor operations, pervious fill shall be placed in lifts not to exceed 8 inches and compacted by means of mechanical tampers, or suitable vibratory equipment. For minor operations, hand tamping with heavy iron tampers may be used.

c. Common Backfill. All spaces excavated and not occupied by permanent works, pervious fill, or gravel borrow, shall be backfilled with suitable material, such material to be compacted in 1-foot lifts up to the surface of the surrounding ground.

Suitable material shall be free of vegetative matter, organic or compressible soils, and shall meet the requirements for Common Borrow except that the material shall not contain particles larger than 6 inches. The Engineer may approve excavated soil for re-use as suitable material.

The surface shall then be neatly graded. Backfill shall be compacted to 95 percent of maximum density as determined by AASHTO T180. No separate payment will be made for this work.

203.03.6 Crushed Stone Fill Under Structures. The crushed stone shall be placed and compacted on a prepared surface to the required thickness indicated on the Plans. A filter fabric must be placed between the crushed stone and surrounding soils. The surface of the crushed stone must be placed in such a manner that a reasonably uniform texture is provided. The surface will have a tolerance of ½-inch, plus or minus, to the grade indicated on the Plans and/or as directed by the Engineer.

203.04 METHOD OF MEASUREMENT.

203.04.1 Structure Excavation. Structure excavation of the various classifications will be measured by the number of cubic yards of the respective materials actually removed in accordance with the Plans and/or as directed by the Engineer. The volume will be computed by taking the difference in elevation between the existing ground surface or the bottom of roadway excavation or channel excavation, whichever is lower, and the surface of the completed structure excavation at plan grade or approved revised plan grade all between the designated horizontal pay lines.

Structure excavation in roadway cuts, or embankment areas where the removal of muck is indicated on the Plans shall include only that portion below the bottom of the muck.

Structure excavation in roadway cuts shall include only that portion below the subgrade, shoulder foundations, and cut slope lines, or as specifically indicated on the Plans.

When bedrock, boulders, or masonry are encountered, the Contractor shall notify the Engineer and shall expose the same to such an extent that in the Engineer's opinion the necessary measurements can be taken for structure excavation. If the Contractor shall fail to give such notice or notices, or removes any material prior to the taking of measurements, the Engineer shall presume that measurements taken at the time the Engineer first sees the material in question will give the true quantity of excavation.

a. Pay Lines. Horizontal payment limits will be measured between plumb lines and 2 feet outside of the neat lines of the original foundations only as shown on the Plans. However, should the size of the footing be increased more than 2 feet in any direction, the area of the footing that extends beyond the original payment lines, as established hereinbefore, will be used for determining the additional amount of excavation.

No allowance for rock overbreak will be made beyond the above limits or more than 6 inches below bottom of footing, unless indicated otherwise on the Plans.

203.04.2 Pervious Fill, Gravel Borrow, and Common Borrow. "Pervious Fill," "Gravel Borrow," and "Common Borrow" will be measured by the number of cubic yards actually placed in accordance with the Plans and/or as directed by the Engineer.

203.04.3 Crushed Stone Fill Under Structures. "Crushed Stone Fill Under Structures" will be measured by the number of cubic yards actually placed in accordance with the Plans and/or as directed by the Engineer.

203.04.4 Cofferdams. Cofferdams do not require a measurement for payment.

203.04.5 Tremie Seals. When underwater concrete is specified, the horizontal and vertical payment limits will be those specified for the tremie seal as indicated on the Plans. When underwater concrete is not specified, but is required, the horizontal payment limits will be extended to the actual inside face of the cofferdam, and the vertical payment limits will be established by the Engineer.

203.05 BASIS OF PAYMENT.

203.05.1 Structure Excavation. The accepted quantities of "Structure Excavation; Earth," "Structure Excavation; Rock," "Structure Excavation; Rock Mechanical," "Structure Excavation; Masonry" and "Unclassified Structure Excavation" will be paid for at their respective contract unit prices per cubic yard as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, materials, and equipment, including dewatering, removal within the prescribed limits, backfilling and disposal of surplus material, and all other incidentals required to finish the work, complete and accepted by the Engineer.

203.05.2 Pervious Fill, Gravel Borrow and Common Borrow. The accepted quantities of "Pervious Fill," "Gravel Borrow," and "Common Borrow" will be paid for at their respective

contract unit prices per cubic yard as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, materials, and equipment, including stockpiling, hauling, placing, compaction, and all other incidentals required to finish the work, complete and accepted by the Engineer.

203.05.3 Crushed Stone Fill Under Structures. The accepted quantity of "Crushed Stone Fill Under Structures" will be paid for at the contract unit price per cubic yard as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, and equipment, including stockpiling, hauling, placing and compaction, preparation of the subgrade, filter fabric and all other incidentals required to finish the work, complete and accepted by the Engineer.

203.05.4 Cofferdams. "Cofferdams" will be paid for at their respective contract lump sum prices as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, materials, and equipment, and all other incidentals required to finish the work, complete and accepted by the Engineer.

203.05.5 Tremie Seals. The accepted quantity of concrete "Tremie Seals" will be paid for at the contract unit price per cubic yard as listed in the Proposal. The price so-stated constitutes full and compete compensation for all labor, materials, and equipment, and all other incidentals required to finish the work, complete and accepted by the Engineer.

SECTION 204

TRIMMING AND FINE GRADING

204.01 DESCRIPTION. This work consists of the trimming and fine grading of all shoulders, ditches, side slopes, sidewalks, and subgrade whether in excavation or embankment. In the case of the subgrade surface, the work also includes the compaction of the surface upon which the pavement structure shall be placed. All such work shall be to the dimensions and details indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

204.02 MATERIALS. Not applicable.

204.03 CONSTRUCTION METHODS. The areas to be graded shall be cleared of unsatisfactory material and shall then be compacted as directed within the areas of the proposed pavement structure.

A tolerance of a maximum of 1 inch, plus or minus, shall be allowed, provided that this plus or minus deviation from grade shall not continue for more than 100 feet in any direction.

Any depressions which may occur during compaction shall then be filled with additional suitable material. The surface shall then be regraded and compacted true to the lines and grades, as required.

The subgrade upon which the pavement structure and sidewalk are placed shall be graded and compacted to 95 percent of maximum density in accordance with **Subsection 202.03.3** of these Specifications. This operation shall be performed prior to pavement structure construction.

All slopes shall be graded and finished to conform with the lines and grades as indicated on the Plans.

Areas to be loamed shall be trimmed and graded to the lines and grades as indicated on the Plans or as directed.

204.04 METHOD OF MEASUREMENT. "Trimming and Fine Grading" will be measured by the number of square yards actually graded in accordance with the Plans and/or as directed by the Engineer.

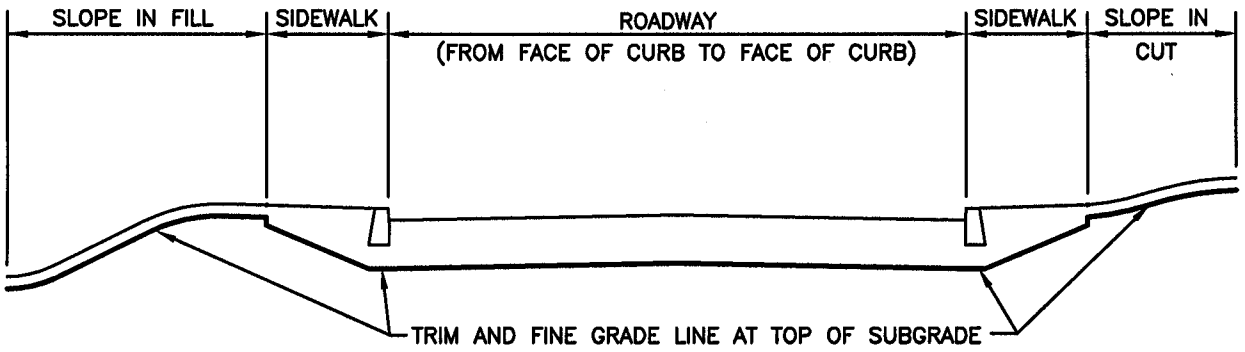
204.04.1 Area to be Measured. In general, the areas of trimming and fine grading to be measured will be the products of the appropriate "lengths" and "widths" as defined below:

a. Length - All Roadway Sections. The length shall be the length of the Contract measured along the roadway centerline.

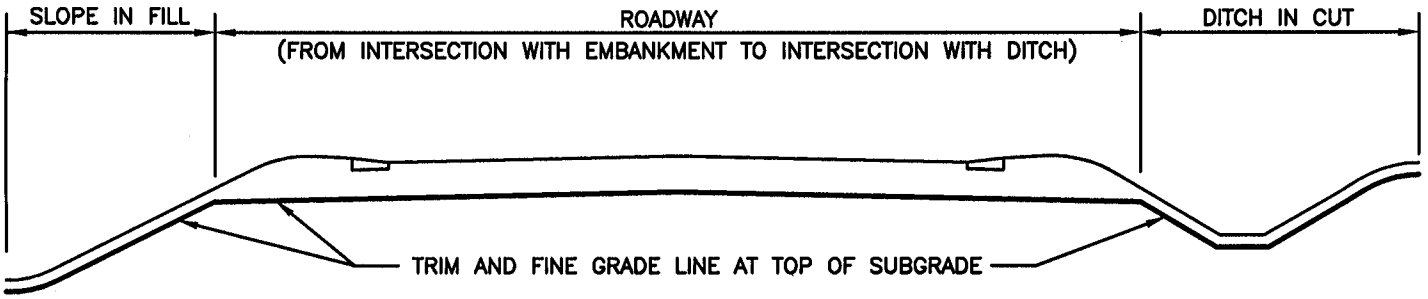
b. Widths. The width shall be the sum of the lengths of the line segments (both straight and curved) which are designated as the "TRIMMING AND FINE GRADING LINE" for representative roadway sections as illustrated on the following page.

204.04.2 Resurfacing/Reconstruction Projects. On resurfacing or reconstruction type projects, lesser limits may be applicable. In such cases measurement limits will be as shown on the Plans or determined by the Engineer.

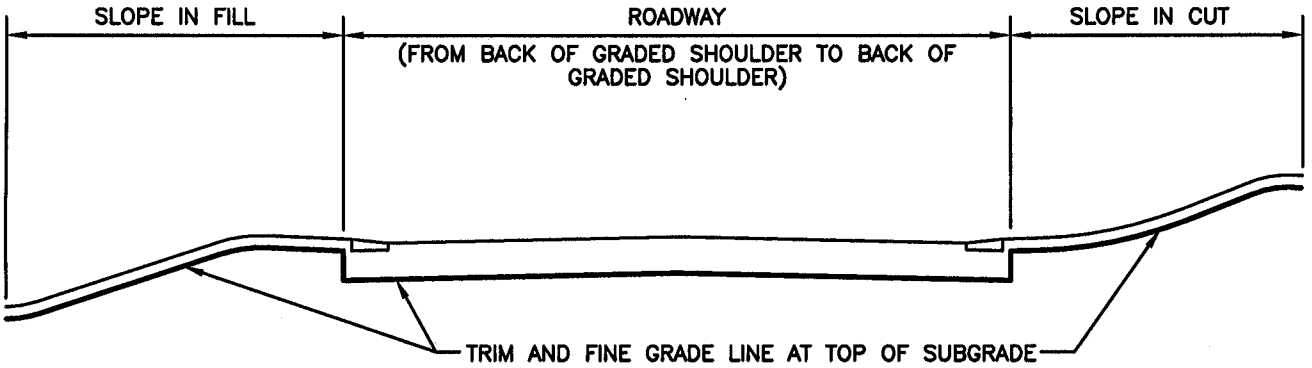
204.05 BASIS OF PAYMENT. The accepted quantity of "Trimming and Fine Grading" will be paid for at the contract unit price per square yard as listed on the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials and equipment and all other incidentals required to finish the work, complete and accepted by the Engineer.



SIDEWALK AND CURB SECTION



OPEN DITCH SECTION (NO CURB/NO SIDEWALK)



CLOSED DRAINAGE SECTION (NO CURB/NO SIDEWALK)

SECTION 205

TRENCH EXCAVATION

205.01 DESCRIPTION. This work consists of the excavation, dewatering, and backfill, or disposal, of all materials required for the construction of box culverts, pipe culverts, storm drains, drainage structures, utilities, utility structures and ditches in reasonably close conformity with the dimension and details indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

Trench excavation also includes the provision of temporary or permanent trench protection as indicated on the Plans and as specified herein.

Trench excavation will be subdivided into the following four classifications:

205.01.1 Trench Excavation; Earth. Trench excavation; earth shall consist of all trench excavation not otherwise classified.

205.01.2 Trench Excavation; Rock. Trench excavation; rock shall consist of the removal of bedrock and boulders or detached rock fragments which have a volume of ½ cubic yard or more. Boulders and detached fragments which have a volume of less than ½ cubic yard are considered Trench Excavation; Earth.

205.01.3 Trench Rock Excavation - Mechanical. This classification of trench rock excavation shall be employed in areas where blasting is prohibited. Trench rock excavated under this classification shall be removed by employing hydraulic splitters, air rams, paving breakers, or any other mechanical methods approved by the Engineer.

205.01.4 Ditches. Ditches at inlets and outlets of culverts and any other ditches and waterways, except those within normal cut and fill slopes, indicated in the Plans shall be excavated under the applicable trench excavation items.

205.02 MATERIALS. Not applicable.

205.03 CONSTRUCTION METHODS.

205.03.1 Excavation of Trenches. All unsuitable material shall be excavated to a minimum depth of 12 inches below the design invert elevation or as directed by the Engineer. For all pipe up to 36 inches in diameter, the width of the trench shall extend 2 feet beyond each side of the inside diameter of the pipe. For pipe greater than 36 inches in diameter, trenches shall be excavated to 30 inches on each side of the inside diameter of the pipe.

The material to replace this excavation shall consist of suitable bedding placed and compacted under and around the pipe to the horizontal and vertical dimensions indicated on the Plans or stated in the Special Provisions. Bedding material may be from suitable trench or roadway excavation material. Backfill placed above the bedding may be from suitable trench or roadway excavation material, provided it meets the minimum requirements for Common Borrow.

Common borrow will be used to replace unsuitable material when no excess suitable material is available from on-site.

The Contractor shall shape the surface of bedding material along the bottom of the trench to fit the bell of pipes to a depth equal to the thickness of the pipe or bell, as directed by the Engineer.

205.03.2 Trench Protection. Should trench protection be required in accordance with either OSHA Regulations or for the protection of the roadway or utilities, the Contractor will be required to provide adequate timber sheeting, steel sheeting or steel box type sheeting acceptable to the Engineer. Should the Contract specifically require trench protection of any nature for drainage trenches not requiring protection under OSHA Regulations, such use will be specified on the construction Plans.

Sheeting shall be either timber of 3-inch minimum thickness; steel sheet piling or a fabricated steel trench box. Except when fabricated steel trench boxes have been approved for use by the Engineer, the Contractor shall submit to the Engineer, for approval, shop drawings and computations showing the method and design of the sheeting proposed for use. Shop drawings shall be prepared and submitted in accordance with **Subsection 105.02; Plans and Shop Drawings**, of these Specifications.

Sheeting and supporting systems shall be designed to meet acceptable engineering criteria and must be certified by a Rhode Island Registered Professional Engineer. The Engineer's approval of shop drawings shall not relieve the Contractor of its responsibility under the Contract for successful completion of the work. The Engineer's written approval of a sheeting design will be required prior to the use of any sheeting on the project and prior to commencement of any drainage or underground utility work.

In all cases where sheeting is to be left in place, it shall be cut off a distance of 2 feet below subgrade unless otherwise required to support adjacent utilities and structures whose elevation is above the aforementioned cut off. The Contractor will not be allowed to use fabricated steel trench boxes where the Contract requires the use of either permanent steel or permanent timber sheeting.

The Contractor will be required to protect any and all structures (drainage or otherwise) and unsupported utilities encountered in the trench.

Unless otherwise indicated on the Plans or directed by the Engineer, all sheeting and bracing used in conjunction with trench excavation shall be removed by the Contractor following the completion of the work.

205.03.3 Open Cuts in Lieu of Trenches. Should the Contractor elect to excavate to the angle of repose as specified in OSHA 2226 (Excavation and Trenching Operations) and the lines of angle of repose intersect the ground beyond the pay limits of trench excavation as described subsequently in **Subsection 205.04.2**, any required additional excavation, disposal of unsuitable material, backfill, borrow, compaction, replacement of pavement structure, curb, sidewalk, lawn area, etc., will be completely at the Contractor's expense. All replacement work shall match the existing in kind. This provision is applicable only if the requirements for the Maintenance and Protection of Traffic are met to the satisfaction of the Engineer and when trench protection is not indicated on the Plans.

205.03.4 Dewatering. Trench excavation shall be maintained dry at all times and all construction work shall be performed in the dry unless otherwise directed by the Engineer. The Contractor shall remove by pumping, draining, bailing, well points, deep wells, or other approved method, any water which may accumulate in the trenches formed under this Contract and shall form all pump wells, sumps, dams, flumes, or other works required to keep the trenches clear of water while pipe and structures are being constructed.

The Contractor shall exercise caution to avoid loss of fines into bedding, boiling up of the trench bottoms, or other disturbances that may cause subsidence or loss of strength of the underlying natural soils. If the dewatering procedure being used results in boiling, loss of fines, or other detrimental effects, the Contractor shall modify its operations to correct the situation. Damage caused by the dewatering operation will be repaired at the Contractor's expense.

All water from the trench excavations, including water discharged from pumping systems and underdrains, shall be removed and legally disposed of.

205.03.5 Backfill and Compaction. Backfill shall consist of suitable bedding and soil materials placed and compacted in layers. These layers shall be compacted to not less than 95 percent of maximum density according to AASHTO T180 and shall be no more than 8 inches thick after compaction.

Compaction shall be achieved in accordance with the applicable provisions of **Subsection 202.03.3** of these Specifications. Unless otherwise directed, the backfill shall be brought to the surface level of the surrounding ground and neatly graded.

No backfill shall be placed against newly constructed masonry or concrete structures unless authorized by the Engineer.

205.04 METHOD OF MEASUREMENT.

205.04.1 Trench Excavation; Earth. "Trench Excavation; Earth" will not be measured for payment.

205.04.2 Trench Excavation; Rock and Trench Rock Excavation - Mechanical. "Trench Excavation; Rock" and "Trench Rock Excavation - Mechanical" will be measured by the cubic yard in its original position within the following horizontal and vertical pay limits:

a. Horizontal Pay Limits. For all pipe up to and including 36 inches in diameter, measurement will be made between parallel vertical planes located 2 feet on each side of the inside diameter of the pipe.

For all pipe greater than 36 inches, measurement will be made between parallel vertical planes located 30 inches on each side of the inside diameter of the pipe.

The length of the trench will be measured from 1 foot beyond the outside face of a drainage structure to 1 foot beyond the outside face of the adjacent drainage structure.

b. Vertical Pay Limits in Cut Areas. Within the limits of Roadway Excavation, payment lines will extend vertically from one foot below the pipe to the subgrade.

Outside the limits of Roadway Excavation, payment lines will extend vertically from one foot below the pipe to existing ground surface.

c. Vertical Pay Limits in Fill. Within the limits of fill areas, payment lines will extend vertically from invert elevation to a maximum cover of approximately 3 feet of fill over the pipe.

205.04.3 Sheeting for Trench Protection.

a. Steel Sheeting. Temporary steel sheeting, temporary steel sheeting abandoned in place, and/or permanent steel sheeting will be measured for payment only if such sheeting is specifically called for on the Plans. In such cases, "Temporary Steel Sheeting," "Temporary Steel Sheeting Abandoned in Place," and/or "Permanent Steel Sheeting" will be measured by the number of square feet calculated according to the following dimensions: The height shall be the distance from the ground surface or the top of sheeting, whichever is less, to 2 feet below the bottom of the excavation. The length of steel sheeting shall be the continuous length measured as described below in **Para. c** of this Subsection.

b. Timber Sheeting. Temporary timber sheeting and/or permanent timber sheeting will be measured for payment only if such sheeting is specifically called for on the Plans. In such cases, "Temporary Timber Sheeting" and/or "Permanent Timber Sheeting" will be measured by the number of square feet calculated according to the following dimensions: The height shall be the distance determined using the vertical pay limits described above in **Para. a** of this Subsection. The length of timber sheeting shall be the continuous length measured as described below in **Para. c** of this Subsection.

c. Prohibition Against Odd Shapes. The inside face of sheeting will be the plane of the horizontal pay limit for trench excavation as noted in, **Subsection 205.04.2; Para. a**. Regardless of the type of sheeting used, timber or steel, measurement will be on the horizontal plane area, not on any odd shapes developed by the sheeting by virtue of its cross-sectional configurations.

d. Open Cuts in Lieu of Trenches. No measurement will be made for additional excavation, disposal of unsuitable material, borrow, compaction, or replacement of site features should the Contractor elect to excavate to the angle of repose in lieu of installing trench protection.

205.05 BASIS OF PAYMENT.

205.05.1 Trench Excavation; Earth. There will be no direct payment for trench excavation; earth required for the installation of drainage pipes, pipe culverts, ditches, utilities or minor structures such as drop inlets, manholes and catch basins or for shaping trenches relative to drainage installations. The cost of such excavation, including dewatering, shall be included in the respective contract unit prices listed in the Proposal for the various classifications of pipe, ditches, and drainage/utility structures.

205.05.2 Trench Excavation; Rock and Trench Rock Excavation - Mechanical. The accepted quantities of "Trench Excavation; Rock" or "Trench Rock Excavation - Mechanical" will be paid for at their respective contract unit prices per cubic yard as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, materials, and

equipment, dewatering, and all other incidentals required to finish the work, complete and accepted by the Engineer.

205.05.3 Backfilling of Trenches. The cost of placing and compacting backfill in trenches is not included in any of the classifications of Trench Excavation. These costs shall be included in the respective contract unit prices listed in the Proposal for the various classifications of pipe and drainage/utility structures. Excavated material which the Engineer determines to be unsuitable or not appropriate for backfilling around or above utilities shall be either removed to stockpile at the direction of the Engineer, or legally disposed of. Any additional borrow material required for trench backfill will be paid for at the contract unit price as listed in the Proposal. If no such unit price is stated in the Proposal, such additional borrow material will be paid for under the provisions of **Subsection 104.05; Extra Work**, of these Specifications.

205.05.4 Sheeting for Trench Protection. Temporary trench protection required for drainage or utility installations shall not be paid for separately unless specifically called for on the Plans. The cost of said trench protection shall be included in the respective contract unit prices listed in the Proposal for the various classifications of pipe and drainage/utility structures.

If fabricated steel trench box type sheeting is used, there will be no separate payment. The cost of fabricated steel trench box type sheeting shall be included in the respective contract unit prices listed in the Proposal for the various classifications of pipe and drainage/utility structures. Fabricated steel trench box type sheeting will not be allowed where either permanent timber sheeting or permanent steel sheeting is specified on the Plans or Special Provisions.

a. Steel Sheeting. If specifically called for on the Plans, the accepted quantities of "Temporary Steel Sheeting," “Temporary Steel Sheeting Abandoned in Place,” and/or "Permanent Steel Sheeting" 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, and equipment, including driving, bracing, cutting and removal of excess quantities, removal of temporary steel sheeting, and all other incidentals required to finish the work, complete and accepted by the Engineer.

b. Timber Sheeting. If specifically called for on the Plans, the accepted quantities of "Temporary Timber Sheeting" and/or "Permanent Timber Sheeting" 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, and equipment, including driving, bracing, cutting off, and removal in the case of temporary sheeting, and all other incidentals required to finish the work, complete and accepted by the Engineer.

205.05.5 Bedding and Backfill Borrows. If specifically called for on the Plans, or if required to replace unsuitable materials, "Bedding and Backfill Borrows" will be paid for at their respective contract unit prices per cubic yard as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, materials, and equipment and all other incidentals required to finish the work, complete and accepted by the Engineer.

If no such unit price is listed in the Proposal and if such material is required, then "Bedding and Backfill Borrows" will be paid for under the provision of **Subsection 104.05; Extra Work**, of these Specifications.

SECTION 206

PERIMETER EROSION CONTROLS

206.01 DESCRIPTION. This work consists of the provision of perimeter erosion controls in reasonably close conformity with the dimensions and details indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications. Perimeter erosion controls consist of the following two types.

206.01.1 Baled Hay Erosion Checks. Baled hay erosion checks shall consist of baled hay or straw, each bale of which is embedded and attached to the ground with wood stakes, and are constructed as indicated on the Plans.

206.01.2 Silt Fence. Silt fencing shall consist of oak fence posts to which are attached industrial support netting and sediment control filter fabric, and are constructed as indicated on the Plans.

206.02 MATERIALS.

206.02.1 Baled Hay Erosion Checks. Baled hay or straw shall be baled within twelve months of use. Bindings shall be sufficiently strong to act as handles when placing bales in position by hand. The minimum dimension of any bale shall be 18 inches. Wood stakes shall be oak, 1-inch by 1-inch in section, and at least 3 feet in length.

206.02.2 Silt Fence. The filter fabric shall be a material suitable for erosion control applications and shall be one of those included on the Department's Approved Materials List. Wood posts shall be oak, 2-inch by 2-inch in section, and at least 4.5 feet in length. Support netting shall be heavy-duty plastic mesh. For prefabricated silt fence, 1-inch by 1-inch wood posts will be permitted.

206.03 CONSTRUCTION METHODS. Those erosion and pollution controls indicated on the Plans shall be installed and approved by the Engineer before the commencement of any drainage, roadway, or bridge construction.

206.03.1 Baled Hay Erosion Checks.

a. Installation. Baled hay erosion checks shall be constructed at the locations, and in accordance with the details indicated on the Plans, or as directed by the Engineer. The following stipulations also apply:

1. Bales shall be placed in a single row, lengthwise on the contour, with ends of adjacent bales tightly abutting one another.

2. The erosion check shall be entrenched and backfilled. The trench shall be excavated the width of the bale and the length of the check to a minimum depth of 3 inches. After the bales are staked and chinked, the excavated soil shall be backfilled against the check. Backfill shall conform to the ground level on the downhill side and shall be built up to 4 inches against the uphill side.

3. The bales are to be installed so that the bindings are oriented around the sides of the bales rather than along their tops and bottoms.

4. Each bale shall be securely anchored by at least two stakes driven through the bale. The first stake in each bale should be driven toward the previously laid bale to force the bales together.

5. The gaps between bales shall be chinked (filled by wedging) with straw to prevent water from escaping between bales. Loose straw shall be scattered over the area immediately uphill from the bale erosion check to increase efficiency.

6. At approximate intervals of 100 feet, one bale is to be placed against those bales positioned along the limit of clearing. This bale is to be placed at a right angle to the line of the toe of slope, all as indicated on the Plans.

b. Removal. All stakes must be removed from the haybales at a time designated by the Engineer. In general the bales will be allowed to rot in place. If the Contract requires the haybales to be removed, they may be removed only when the adjacent exposed area has been stabilized, i.e., the area has an established grass or stone cover or has been paved, and is free from future uncontrolled discharges. Prior to such removal, however, all silt, mud, and debris entrapped by the haybales shall be removed and the area cleaned up in accordance with the applicable provisions of **SECTION 212** of these Specifications. Immediately upon removal of the bales the remaining exposed areas (under the bales) will be backfilled, raked, and graded as necessary to match the surrounding grade and then seeded.

206.03.2 Silt Fence.

a. Installation. Silt fence shall be constructed at the locations, and in accordance with the details indicated on the Plans, or as directed by the Engineer. The following stipulations also apply:

1. A 6-inch by 6-inch minimum trench shall be dug where the fence is to be installed.

2. The fence shall be positioned in the trench with the fence posts set at 8 feet on center (maximum).

3. The sedimentation control fabric and the industrial netting shall be stapled to each post. When joints are necessary, filter fabric shall be spliced together only at support posts. Splices shall consist of a 6-inch overlap, and shall be securely sealed.

4. Each wood post with industrial support netting and filter fabric attached shall be driven into the undisturbed soil in the trench as indicated on the Plans.

5. The trench shall be backfilled and the soil compacted over the filter fabric.

6. The installed height of the fence shall be 2½ feet (minimum). However, height shall not exceed 36 inches since higher barriers impound volumes of water sufficient to cause failure of the fence structure.

b. Removal. This work will include the removal of the silt fence erosion checks and posts. Silt fence will not be left to rot in place. The silt fence may be removed only when the

adjacent exposed area is stabilized, i.e., the area has an established grass or stone cover or has been paved, and is free from future uncontrolled discharges. Prior to such removal, however, all silt, mud, and debris entrapped by the silt fence shall be removed and the area cleaned up in accordance with the applicable provisions of **SECTION 212** of these Specifications. Immediately upon removal of the silt fence the remaining exposed areas will be finished as specified above in **Para. b** of **Subsection 206.03.1**.

206.04 METHOD OF MEASUREMENT.

206.04.1 Baled Hay Erosion Checks. "Baled Hay Erosion Checks" will be measured by the number of linear feet actually installed in accordance with the Plans and/or as directed by the Engineer.

a. Removal. If required by the Contract, "Removal of Baled Hay Erosion Checks" will be measured by the number of linear feet actually removed in accordance with the Plans and/or as directed by the Engineer.

206.04.2 Silt Fence. "Silt Fence" erosion checks will be measured by the number of linear feet actually installed in accordance with the Plans and/or as directed by the Engineer.

206.05 BASIS OF PAYMENT.

206.05.1 Baled Hay Erosion Checks. The accepted quantity of "Baled Hay Erosion Checks" will be paid for at the contract unit price per linear foot as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials and equipment including excavation, haybales, stakes, removal of stakes, and all other incidentals required to finish the work, complete and accepted by the Engineer.

a. Removal. If required by the Contract, the accepted quantity of "Removal of Baled Hay Erosion Checks" will be paid for at the contract unit price per linear foot as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, and equipment including, removal of hay, grading, raking, and seeding necessary to match the surrounding area, and all other incidentals required to finish the work complete and accepted by the Engineer.

206.05.2 Silt Fence. The accepted quantity of "Silt Fence" erosion checks will be paid for at the contract unit price per linear foot as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials and equipment including excavation, filter fabric, industrial netting, posts, removal of fence, grading, raking and seeding necessary to match the surrounding area, and all other incidentals required to finish the work complete and accepted by the Engineer.

206.05.3 Cleaning and Maintenance. The cleaning and maintenance of Baled Hay Erosion Checks and Silt Fence Erosion Checks will be paid for under the provisions of **SECTION 212; MAINTENANCE AND CLEANING OF EROSION AND POLLUTION CONTROLS.**

SECTION 207

CHECK DAMS

207.01 DESCRIPTION. This work consists of the provision of check dams and dikes in reasonably close conformity with the dimensions and details indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications. Check dams consist of the following four types:

207.01.1 Baled Hay Ditch and Swale Erosion Checks. Baled hay ditch and swale erosion checks consist of baled hay or straw, each bale of which is embedded and attached to the ground with wood stakes, and constructed as indicated on the Plans.

207.01.2 Log and Hay Check Dams. Log and hay check dams consist of baled hay placed inside a log enclosure and held in place and otherwise stabilized by the placement of stones, and constructed as indicated on the Plans.

207.01.3 Sand Bag Erosion Dikes. This work consists of the placement of sand bags across either riprap or earth ditches, thereby forming a dike, to create temporary stilling basins for pollution control, and constructed as indicated on the Plans.

207.01.4 Stone Check Dams. This work consists of the placement of stone in ditches or drainage swales, and constructed as indicated on the Plans.

207.02 MATERIALS.

207.02.1 Baled Hay Ditch and Swale Erosion Checks. Baled hay or straw shall be baled within twelve months of use. Bindings shall be sufficiently strong to act as handles when placing bales in position by hand. The minimum dimension of any bale shall be 18 inches. Wood stakes shall be oak, 1-inch by 1-inch in section, and at least 3 feet in length.

207.02.2 Log and Hay Check Dams. Baled hay or straw shall conform to the requirements of **Subsection 207.02.1**, above. Wire spikes shall be of a quality acceptable to the Engineer. Crushed stone shall meet the requirements of **Subsection M.01.09; Table I, Column II** of these Specifications. Other natural materials such as rocks and cut logs shall both conform to the dimensions and sizes indicated on the Plans and be acceptable to the Engineer.

207.02.3 Sand Bag Erosion Dikes. The sand bags and the sand material shall be of a quality acceptable to the Engineer. Dumped stone, when required, shall meet the requirements of **Subsection M.10.03.2** for Modified NSA Class R-4 riprap. The filled sand bags will weigh a minimum of 60 pounds.

207.02.4 Stone Check Dams. The stone shall meet the requirements of **Subsection M.01.09, Table I, Column V** for Filter Stone.

207.03 CONSTRUCTION METHODS. Those erosion and pollution controls indicated on the Plans shall be installed and approved by the Engineer before the commencement of any drainage, roadway or bridge construction.

207.03.1 Baled Hay Ditch and Swale Erosion Checks.

a. Installation. Erosion checks shall consist of two or more bales placed and staked perpendicular to the flow line of a ditch formed by the intersection of its slopes and constructed as indicated on the Plans. The following stipulations also apply:

1. A pair of erosion checks shall be placed a minimum of 12 feet apart at each location.

2. The ditch erosion checks shall be entrenched and backfilled. The trench shall be excavated the width of the bale(s) and the length of the check to a minimum depth of 3 inches. After the bales are staked and chinked, the excavated soil shall be backfilled against the check. Backfill shall conform to the ground level on the downhill side and shall be built up to 4 inches against the uphill side.

3. The bales are to be installed so that the bindings are oriented around the sides of the bales rather than their tops and bottoms.

4. The edges of overlapped bales shall overlap in such a manner that there will be no opening between the bales. Where bales butt together the gap between bales shall be chinked with loose straw to prevent water from escaping.

5. Each bale shall be securely anchored by a least two stakes driven through the bale. The first stake in each bale should be driven toward the previously laid bale to force the bales together.

6. All earth ditch areas are required to have the protection of baled hay ditch erosion checks prior to their outfall onto existing ground, or natural or man-made water courses.

7. The haybale barrier shall be extended such a length that the bottoms of the end bales are higher in elevation than the top of the lowest middle bale. This configuration will insure that the sediment laden runoff will flow either through or over the barrier, but not around it.

b. Removal. Bales of hay used in this work will not normally be left to rot in place. The bales may be removed only when the adjacent exposed area is stabilized, i.e., the area has an established grass or stone cover or has been paved, and is free from future uncontrolled discharges. Prior to such removal, however, all silt, mud, and debris entrapped by the respective erosion checks shall be removed and the area cleaned up in accordance with the applicable provisions of **SECTION 212** of these Specifications. Immediately upon removal of the bales, the remaining exposed areas (under the bales) will be backfilled, raked, and graded as necessary to match the surrounding grade and then seeded.

207.03.2 Log and Hay Check Dams.

a. Installation. Log and hay check dams will be constructed perpendicular to the stream flow line. The bales of hay shall be placed between 18-inch log walls, nailed, braced and weighted with stone as indicated on the Plans.

b. Removal. Log and hay check dams will be removed prior to the completion of the project at a time designated by the Engineer. Prior to such removal, however, all silt, mud, and

debris entrapped by the check dam shall be removed and the area cleaned up in accordance with the applicable provisions of **SECTION 212** of these Specifications. Immediately upon removal of the check dams, the exposed and disturbed areas will be backfilled, raked, and graded as necessary to match the surrounding area and then seeded.

207.03.3 Sand Bag Erosion Dikes.

a. Installation. Sand bag erosion dikes shall be constructed as indicated on the Plans. The sand bags will be placed a minimum of four layers high. Over the center of the ditch the top layer of sand bags will have a weir opening equal to one half the bottom ditch width. The sand bags shall be extended such a length that the bottom of the end sand bags are higher in elevation than the top of the lowest middle sand bag.

When the sand bag dike is constructed across an earth ditch, the down stream side of the dike at the weir opening is to be protected with Modified NSA Class R-4 dumped riprap.

b. Removal. Sand bag erosion dikes will be removed prior to the completion of the project at a time designated by the Engineer. Prior to such removal, however, all silt, mud, and debris entrapped by the erosion dike shall be removed and the area cleaned up in accordance with the applicable provisions of **SECTION 212** of these Specifications.

207.03.4 Stone Check Dams.

a. Installation. Stone check dams shall be constructed as indicated in on the Plans. The stone shall be placed across the ditch or swale to achieve complete coverage and shaped to the required configuration by the use of hand tools. The stone shall be sloped from the sides of the ditch/swale towards the center such that the center is 6 inches lower than the stone at the sides of the ditch/swale. The check dam shall have 2 horizontal to 1 vertical side slopes and shall not exceed 2 feet in height.

b. Removal. Stone check dams will be removed prior to the completion of the project at a time designated by the Engineer. Prior to such removal, however, all silt, mud and debris entrapped by the check dam shall be removed and the area cleaned up in accordance with the applicable provisions of **SECTION 212** of these Specifications.

207.04 METHOD OF MEASUREMENT.

207.04.1 Baled Hay Ditch and Swale Erosion Checks. "Baled Hay Ditch and Swale Erosion Checks" will be measured by the number of linear feet of hay bales actually installed in accordance with the Plans and/or as directed by the Engineer.

207.04.2 Log and Hay Check Dams. "Log and Hay Check Dams" will be measured by the number of linear feet actually installed in accordance with the Plans and/or as directed by the Engineer.

207.04.3 Sand Bag Erosion Checks. "Sand Bag Erosion Checks" will be measured by the number of sand bags actually provided in accordance with the Plans and/or as directed by the Engineer.

207.04.4 Stone Check Dams. "Stone Check Dams" will be measured by the number of cubic feet of stone actually placed in accordance with the Plans and/or as directed by the Engineer.

207.05 BASIS OF PAYMENT.

207.05.1 Baled Hay Ditch and Swale Erosion Checks. The accepted quantity of "Baled Hay Ditch and Swale Erosion Checks" will be paid for at the contract unit price per linear foot as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, and equipment including excavation, hay bales, stakes, the subsequent removal of bales and stakes, backfill, grading, seeding, and all other incidentals required to finish the work, complete and accepted by the Engineer.

207.05.2 Log and Hay Check Dams. The accepted quantity of "Log and Hay Check Dams" will be paid for at the contract unit price per linear foot as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, and equipment including hay bales, logs, nails, crushed stone wedge, ballast stones, the subsequent removal of the log and hay dam, grading, seeding, and all other incidentals required to finish the work, complete and accepted by the Engineer.

207.05.3 Sand Bag Erosion Checks. The accepted quantity of "Sand Bag Erosion Checks" will be paid for at the contract unit price per each bag as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, equipment and materials, including bags, sand, the subsequent removal of sand bags, and all other incidentals required to finish the work, complete and accepted by the Engineer.

207.05.4 Stone Check Dams. The accepted quantity of "Stone Check Dams" will be paid for at the contract unit price per cubic foot as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, and equipment, the subsequent removal of the stone, and all other incidentals required to finish the work, complete and accepted by the Engineer.

207.05.5 Cleaning and Maintenance. The cleaning and maintenance of Baled Hay Ditch and Swale Erosion Checks, Log and Hay Check Dams, Sand Bag Erosion Checks, and Stone Check Dams will be paid for under the provisions of **SECTION 212; MAINTENANCE AND CLEANING OF EROSION AND POLLUTION CONTROLS.**

SECTION 208

TEMPORARY DEWATERING BASINS

208.01 DESCRIPTION. This work consists of the provision of temporary dewatering basins for the purpose of controlling water pollution caused by sediment-laden discharge from excavation sites. The basins shall be constructed in reasonably close conformity with the dimensions and details indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications. Temporary dewatering basins consist of the following two types:

208.01.1 Dewatering Basin. The basin consists of a rectangular concrete barrier enclosure, the bottom and sides of which are lined with filter fabric. The bottom fabric is stabilized with filter

stone. The basin is divided into the required number of 12-foot sections by stone berms approximately 18 inches high. The entire unit is constructed as indicated on the Plans.

208.01.2 Filter Fabric Retention Basin. The basin consists of a rectangular enclosure formed by a 2-foot high chain link fence. Both the fence and the bottom of the enclosure are lined with filter fabric which is stabilized by a layer of rock riprap. The entire unit is constructed as indicated on the Plans.

208.02 MATERIALS.

208.02.1 Dewatering Basins. Precast concrete barrier units shall conform to details indicated on the Plans and to the applicable requirements of **SECTION 909** of these Specifications. Filter fabric shall conform to the applicable requirements of **Subsection 206.02.2; Silt Fence**, of these Specifications. Filter stone shall conform to the requirements of **Subsection M.01.09, Table I, Column V** of these Specifications. Sand bags shall be of a quality acceptable to the Engineer. Hay bales and wood stakes shall conform to the requirements of **Subsection 206.02.1** of these Specifications.

208.02.2 Filter Fabric Retention Basins. The fence shall conform to the requirements for Type I Chain Link Fence as set forth in **SECTION 903** of these Specifications. Wood posts shall be 2-inch by 2-inch oak and at least 3 feet in length. Filter fabric shall conform to the requirements for same as set forth in **Subsection 206.02.2** of these Specifications. The layer of stone over the bottom of the basin shall meet the requirements of **Subsection M.10.03.2** for Modified NSA Class R-4 riprap.

208.03 CONSTRUCTION METHODS. Those erosion and pollution controls indicated on the Plans shall be installed and approved by the Engineer before the commencement of any drainage, roadway, or bridge construction.

208.03.1 Dewatering Basin.

a. Installation. Dewatering basins shall be constructed at the locations, and in accordance with the details indicated on the Plans, or as directed by the Engineer. The following stipulations shall also apply:

1. The precast concrete barrier units shall be placed on level, or nearly level, ground.

2. Filter fabric shall be placed on the bottom of the entire area enclosed by the concrete barrier units. If more than one sheet of fabric is required, the adjacent section shall be overlapped a minimum of 12 inches to insure full coverage. Filter fabric shall be turned up along the inside face of the concrete barriers to the top of same, there to be folded across the top of the barriers. The fabric will be maintained in position by the placement of sand bags, end-to-end, along the top of the concrete barrier enclosure.

3. A minimum layer of 6 inches of filter stone shall be spread over the bottom of the basin. Stone berms shall be constructed at 12-foot intervals along the length of the basin.

b. Removal. The dewatering basin will not be removed until all dewatering operations are complete. Prior to such removal, however, all accumulated sediment within the basin shall

be removed and legally disposed of in accordance with the applicable requirements of **SECTION 212** of these Specifications. The area covered by the basin shall be seeded and mulched immediately after the basin is removed.

208.03.2 Filter Fabric Retention Basin.

a. Installation. Retention basins shall be constructed at the locations, and in accordance with the details indicated on the Plans, or as directed by the Engineer. The following stipulations shall also apply:

1. The filter fabric retention basin will be placed on stabilized and level, or nearly level, ground to prevent erosion by water exiting the basin.

2. A 6-inch by 6-inch minimum trench shall be dug where the basin is to be constructed.

3. The filter fabric and wire backing shall be 3 feet wide (minimum) positioned in the trench and secured to metal posts positioned 4 feet on center (maximum).

4. The metal posts shall be driven into undisturbed soil next to the trench to a minimum depth of 12 inches.

5. Place fill material in the trench and compact.

6. The installed height of the fence shall be 2 feet (minimum).

7. A minimum layer of 6 inches of filter stone (Modified NSA Class R-4 riprap) shall be spread evenly over the bottom of the basin.

b. Removal requirements for the filter fabric retention basin are the same as set forth above for the dewatering basin.

208.04 METHOD OF MEASUREMENT. "Dewatering Basins" and "Filter Fabric Retention Basins" will be measured by the number of square feet of each such basin actually provided in accordance with the Plans and/or as directed by the Engineer. Area will be computed based on the outside dimensions of the basin enclosures.

208.05 BASIS OF PAYMENT. The accepted quantities of "Dewatering Basins" and "Filter Fabric Retention Basins" 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, and equipment, including installation, subsequent removal, and restoration of basin areas, and all other incidentals required to finish the work, complete and accepted by the Engineer.

208.05.1 Cleaning and Maintenance. The cleaning and maintenance of Dewatering Basins and Filter Fabric Retention Basins will be paid for under the provisions of **SECTION 212; MAINTENANCE AND CLEANING OF EROSION AND POLLUTION CONTROLS.**

SECTION 209

STORM DRAIN PROTECTION

209.01 DESCRIPTION. This work consists of the provision of temporary storm drain protection facilities constructed in reasonably close conformity with the dimensions and details indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications. Storm drain protection facilities consist of the following three types.

209.01.1 Sandbag Gutter Inlet Sediment Barrier. This work consists of placing a sandbag barrier upstream of a gutter inlet prior to the placement of roadway pavement. Sediment barriers shall be constructed as indicated on the Plans.

209.01.2 Silt Fence Catch Basin Inlet Protection. This work consists placing a temporary filter fabric fence around inlet grates. Silt fence inlet protection shall be constructed as indicated on the Plans.

209.01.3 Baled Hay Catch Basin Inlet Protection. This work consists of placing baled hay around catch basin inlets. Baled hay inlet protection shall be constructed as indicated on the Plans.

209.02 MATERIALS.

209.02.1 Sandbag Gutter Inlet Sediment Barrier. The sandbags and the sand material shall be of a quality acceptable to the Engineer.

209.02.2 Silt Fence Catch Basin Inlet Protection. The filter fabric shall be a material suitable for erosion control applications and shall be one of those included on the Department's Approved Materials List. Wood posts shall be oak, 2-inch by 2-inch in section, and at least 4½ feet in length. Support netting shall be heavy-duty plastic mesh. For prefabricated silt fence, 1-inch by 1-inch wood posts will be permitted.

209.02.3 Baled Hay Catch Basin Inlet Protection. Baled hay or straw and wood stakes shall conform to the requirements of **Subsection 206.02.1** of these Specifications.

209.03 CONSTRUCTION METHODS. Those erosion and pollution controls indicated on the Plans shall be installed and approved by the Engineer before the commencement of any drainage, roadway, or bridge construction.

209.03.1 Sandbag Gutter Inlet Sediment Barrier.

a. Installation. Sandbag sediment barriers shall be constructed as indicated on the Plans. The following stipulations shall also apply:

1. The sandbags will be placed in a curved row extending from the curb or berm. The row shall be at least 6 feet upstream of the inlet and should overlap the curb or berm.

2. Place several layers of sandbags over the first layer to a height of at least 1 foot. The bags shall be overlayed and packed tightly together.

3. A gap of one sandbag should be left in the middle of the top row to serve as a spillway. The spillway shall be a least 8 inches high.

4. Additional sediment storage capacity can be obtained by constructing a series of these barriers along the gutter upstream of the inlet.

b. Removal. The sandbag sediment barrier will be removed prior to the completion of the project at a time designated by the Engineer. Prior to such removal, however, all silt, mud, and debris entrapped by the sediment barrier shall be removed and the area cleaned up in accordance with the applicable provisions of **SECTION 212** of these Specifications.

209.03.2 Silt Fence Catch Basin Inlet Protection.

a. Installation. The silt fence inlet protection shall be constructed as indicated on the Plans. The following stipulations shall also apply:

1. Posts shall extend at least 1 foot below grade.

2. The filter fabric shall extend to a height at least 12 inches above the top of the inlet grate, but shall not exceed 3 feet in height.

3. The support netting shall extend to the full height of the filter fabric.

4. A trench shall be excavated approximately 6 inches wide and 6 inches deep around the outside perimeter of the stakes. The filter fabric and support netting shall extend at least 6 inches into the trench. After the fabric and support netting are fastened to the stakes the trench should be backfilled and compacted to original grade.

5. The filter fabric and support netting fence shall be securely fastened to the stakes using heavy duty wire staples at least 1 inch long. Ends of the filter fabric must meet at a stake, be overlapped, folded and stapled to the stake.

b. Removal. The silt fence inlet protection shall be removed and the area prepared for pavement construction once the contributing drainage area is free from future uncontrolled discharges. Prior to such removal, however, all silt, mud, and debris entrapped by the silt fence shall be removed and the area cleaned up in accordance with the applicable provisions of **SECTION 212** of these Specifications.

209.03.3 Baled Hay Catch Basin Inlet Protection.

a. Installation. The baled hay inlet protection shall be constructed as indicated on the Plans. The following stipulations shall also apply:

1. The bales shall be entrenched and backfilled. The trench shall be excavated the width of the bale and the length of the check to a minimum depth of 3 inches. After the bales are staked and chinked, the excavated soil shall be backfilled against the check. Backfill shall conform to the ground level on the inside and shall be built up to 4 inches around the outside.

2. The bales are to be installed so that the bindings are oriented around the sides of the bales rather than along their tops and bottoms.

3. Each bale shall be securely anchored by at least two stakes driven through the bale. The first stake in each bale should be driven toward the previously laid bale to force the bales together.

4. The gaps between bales shall be chinked (filled by wedging) with straw to prevent water from escaping between bales.

b. Removal. The baled hay inlet protection shall be removed and the area prepared for pavement construction the contributing drainage area is free from future uncontrolled discharges. Prior to such removal, however, all silt, mud, and debris entrapped by the baled hay shall be removed and the area cleaned up in accordance with the applicable provisions of **SECTION 212** of these Specifications.

209.04 METHOD OF MEASUREMENT.

209.04.1 Sandbag Gutter Inlet Barrier. "Sandbag Gutter Inlet Sediment Barriers" will be measured by the number of sandbags actually provided in accordance with the Plans and/or as directed by the Engineer.

209.04.2 Silt Fence Catch Basin Inlet Protection. "Silt Fence Catch Basin Inlet Protection" will be measured by the number of linear feet of such protection actually installed in accordance with the Plans and/or as directed by the Engineer.

209.04.3 Baled Hay Catch Basin Inlet Protection. "Baled Hay Catch Basin Inlet Protection" will be measured by the number of linear feet of hay bales actually installed in accordance with the Plans and/or as directed by the Engineer.

209.05 BASIS OF PAYMENT.

209.05.1 Sandbag Gutter Inlet Sediment Barriers. The accepted quantity of "Sandbag Gutter Inlet Sediment Barriers" will be paid for at the contract unit price per each bag as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, equipment and materials, including bags, sand, the subsequent removal of sandbags, and all other incidentals required to finish the work, complete and accepted by the Engineer.

209.05.2 Silt Fence Catch Basin Inlet Protection. The accepted quantity of "Silt Fence Catch Basin Inlet Protection" will be paid for at the contract unit price per linear foot as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, and equipment including excavation, stakes, support netting, filter fabric, backfill, the subsequent removal of the entire temporary facility, and all other incidentals required to finish the work, complete and accepted by the Engineer.

209.05.3 Baled Hay Catch Basin Inlet Protection. The accepted quantity of "Baled Hay Catch Basin Inlet Protection" will be paid for at the contract unit price per linear foot as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, and equipment including excavation, haybales, stakes, backfill, the subsequent removal of the

entire temporary facility, and all other incidentals required to finish the work, complete and accepted by the Engineer.

209.05.4 Cleaning and Maintenance. The cleaning and maintenance of Sandbag Gutter Inlet Sediment Barriers, Silt Fence Catch Basin Inlet Protection, and Baled Hay Catch Basin Inlet Protection will be provided and paid for under the provisions of **SECTION 212; MAINTENANCE AND CLEANING OF EROSION AND POLLUTION CONTROLS.**

SECTION 210

STILLING BASINS FOR WATER POLLUTION CONTROL

210.01 DESCRIPTION. This work consists of the provision of temporary and/or permanent stilling basins in reasonably close conformity with the dimensions and details indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

210.02 MATERIALS. The various materials required for the construction of stilling basins will be indicated on the Plans.

210.03 CONSTRUCTION METHODS. The stilling basins will be constructed in such a manner to allow any material which may cause a natural water course or the surrounding environment to be damaged to be retained in the basin. During the life of the Contract, the Contractor will be required to periodically clean the pool and to maintain the basin, both as directed by the Engineer. If the basin is temporary, the Contractor will be required to fill the basin with suitable material and to restore the area in which the basin was located to either its original condition or to the requirements of the Contract.

In all cases the stilling basins are to be constructed immediately after the clearing and grubbing operation and before commencement of any excavation and/or embankment. The single exception to this requirement is the construction of a leveling course to create a work platform. Excavation for stilling basins is to take place from the downstream end of the basin and to proceed upstream. Prior to the start of excavation, temporary baled hay ditch erosion checks and/or hay log check dams are to be constructed immediately beyond the downstream end of the basin. When the basin is complete the above temporary erosion control measures are to be removed.

210.04 METHOD OF MEASUREMENT. "Stilling Basins for Water Pollution Control" will not be measured by a single unit of measurement usually associated with a specific Proposal item. Rather, each individual item of work required to provide such basins will be measured by their respective units of measurement for the quantity actually provided in accordance with the Plans and/or as directed by the Engineer.

210.05 BASIS OF PAYMENT. "Stilling Basins for Water Pollution Control" will not be paid for as completed facilities. Rather, such basins will be paid for at the contract unit prices listed in the Proposal for those various items of work required to both construct the facility, and in the cases

of temporary basins, those items of work necessary to remove the basin and restore the area to its original or proposed condition.

210.05.1 Cleaning and Maintenance. The cleaning and maintenance of Stilling Basins will be paid for under the provisions of **SECTION 212; MAINTENANCE AND CLEANING OF EROSION AND POLLUTION CONTROLS.**

SECTION 211

CONSTRUCTION ACCESSES

211.01 DESCRIPTION. This work consists of the provision of stabilized stone pads located at points of vehicular ingress and egress on construction sites.

211.01.1 Planning Considerations. Public roads adjacent to a construction site shall be clean at the end of each day. This **SECTION 211** provides for an area where mud can be removed from the tires of construction vehicles before such vehicles enter a public road. The action of vehicles traveling over a stabilized stone pad will remove most of the mud from tires. Construction accesses shall be used in conjunction with the stabilization of construction roads to reduce the amount of mud picked up by construction vehicles.

211.02 MATERIALS. Crushed stone shall conform to the requirements of **Subsection M.01.09, Table I, Column II** of these Specifications. Filter fabric shall conform to the requirements for same as set forth in **Subsection 206.02.2** of these Specifications.

211.03 CONSTRUCTION METHODS. Stabilized stone pads employed as construction entrances shall be constructed as indicated on the Plans.

211.03.1 Entrance Dimensions.

a. Thickness. The thickness of the stabilized stone pad shall be a minimum of 5 inches.

b. Width. The width shall not be less than the full width of the respective points of ingress or egress.

c. Length. The length of construction entrances shall be at least 50 feet where the soils are sands or gravels, except where the traveled length is less than 50 feet. Where soils are clays or silts, the length of construction entrances shall be at least 100 feet except where the traveled length is less than 100 feet.

211.03.2 Installation Requirements. The area of the construction entrance shall be cleared of all vegetation, roots, stumps, or other objectionable material. The area shall then be excavated to subgrade and graded. Filter fabric shall be placed on the prepared subgrade prior to the placement of the stone pad. The stone shall be placed according to the specified dimensions.

211.04 METHOD OF MEASUREMENT. "Construction Accesses" will be measured by the number of square yards of stabilized stone pads actually installed for this purpose in accordance with the Plans and/or as directed by the Engineer.

211.05 BASIS OF PAYMENT. The accepted quantity of "Construction Accesses" will be paid for at the contract unit price per square yard as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, material and equipment including excavating, filter fabric, stabilized stone pad, and subsequent removal of same, and all other incidentals required to finish the work complete and accepted by the Engineer.

SECTION 212

MAINTENANCE AND CLEANING OF EROSION AND POLLUTION CONTROLS

212.01 DESCRIPTION. This work consists of the maintenance and cleaning of erosion and pollution control facilities in accordance with these Specifications and as directed by the Engineer.

212.01.1 Applicable Controls. The specific erosion and pollution control facilities to be cleaned and maintained under this Section consist of the following:

a. Perimeter Controls.

1.	Baled Hay Erosion Checks;	Subsection 206.01.1
2.	Silt Fence;	Subsection 206.01.2

b. Check Dams.

1.	Baled Hay Ditch and Swale Erosion Checks;	Subsection 207.01.1
2.	Log and Hay Check Dams;	Subsection 207.01.2
3.	Sand Bag Erosion Dikes;	Subsection 207.01.3
4.	Stone Check Dams;	Subsection 207.01.4

c. Temporary Dewatering Basins.

1.	Dewatering Basins;	Subsection 208.01.1
2.	Filter Fabric Retention Basins;	Subsection 208.01.2

d. Storm Drain Protection.

1.	Sandbag Gutter Inlet Sediment Barrier;	Subsection 209.01.1

2. Silt Fence Catch Basin Inlet Protection; Subsection 209.01.2

3. Baled Hay Catch Basin Inlet Protection; Subsection 209.01.3

e. Stilling Basins. Subsection 210.01

212.01.2 Definitions.

a. Cleaning. Cleaning consists of removing debris and accumulated sediment-laden deposits from the upstream side of perimeter controls, check dams and temporary drainage protection **and** from the bottom of temporary dewatering basins and stilling basins. All material so-removed shall be legally disposed of.

b. Maintenance. Maintenance consists of the repair and restoration to original configuration of damage sustained by erosion and pollution controls caused by "normal" rainfall events. (Abnormal weather events are defined in **Subsection 212.03.4; Failure of Erosion and Pollution Controls**).

212.02 MATERIALS. Materials required to repair and restore damaged erosion and pollution controls shall meet the applicable requirements of **Subsections 206.02; 207.02; 208.02; 209.02; and 210.02; for Perimeter Erosion Controls, Check Dams, Temporary Dewatering Basins, Storm Drain Protection, and Stilling Basins**, respectively, of these Specifications.

212.03 CONSTRUCTION METHODS. Erosion and pollution controls shall be maintained by the Contractor to the satisfaction of the Engineer. Erosion and pollution controls must be able to prevent, under normal weather conditions, both the movement of soil materials and the intrusion of sediment-laden discharges into environmentally sensitive areas.

Construction shall not commence or continue until all specified erosion and pollution controls are in place, properly installed and accepted by the Engineer.

Erosion and pollution controls shall be routinely inspected by the Engineer. The Engineer shall notify the Contractor immediately if problems develop. The Contractor shall commence cleaning and maintenance measures no later than the next consecutive calendar day after receiving a directive from the Engineer to perform such measures. The Contractor shall aggressively and expeditiously perform such cleaning and maintenance work until the original problem is remedied to the complete satisfaction of the Engineer. In the event of a weekend storm, the Contractor must have resources available to restore, and, if necessary, to replace any damaged controls.

212.03.1 Threshold for Cleaning Erosion Controls. Erosion and pollution controls will be cleaned when directed by the Engineer; after a rainstorm; and when sediment deposits reach the heights indicated in the following table:

a. Perimeter Controls		**Height**
1.	Baled Hay Erosion Checks	½ Bale Height
2.	Silt Fence	6 inches
b. Check Dams		
1.	Baled Hay Erosion Checks	½ Bale Height
2.	Log and Hay Check Dams	½ Bale Height
3.	Sand Bag Erosion Dike	½ Dike Height
4.	Stone Check Dam	½ Dam Height
c. Temporary Dewatering Basins		
1.	Dewatering Basins	½ Original Basin Height
2.	Filter Fabric Retention Basin	½ Original Basin Height
d. Storm Drain Protection		
1.	Sandbag Gutter Inlet Sediment Barrier	½ Dike Height
2.	Silt Fence Catch Basin Inlet Protection	6 inches
3.	Baled Hay Catch Basin Inlet Protection	½ Bale Height
e. Stilling Basins		½ Depth Below Outlet Elevation

212.03.2 Other Requirements.

a. Perimeter Controls, Check Dams and Storm Drain Protection. The following requirements apply:

1. Damaged controls will be repaired or replaced after each storm events or as directed by the Engineer.

2. Before controls are removed all accumulated sediment on the upstream side shall be removed and legally disposed of.

3. Erosion controls shall not be removed until the adjacent exposed areas are relatively free from future uncontrolled discharges.

4. The Engineer has the authority to verify, enforce, and to specify maintenance activities and to ensure that erosion and pollution controls have been properly maintained.

b. Temporary Dewatering Basins and Stilling Basins. The following requirements apply:

1. The basins will be periodically inspected for signs of erosion around the basin and downslope area.

2. Repairs will be promptly carried out as directed by the Engineer.

3. The Engineer has the authority to verify, enforce, and to specify maintenance activities and to ensure that controls have been properly maintained.

212.03.3 Failure to Maintain Erosion and Pollution Controls. If the Engineer decides on any given day that those erosion and pollution controls specified in the Contract are not in place or have not been adequately maintained as specified in this Section, the daily charge set forth in **Special Provision Code 212.1000** will be deducted from monies due the Contractor as a charge for failure to comply with this Specification. Moreover, the stated daily charge will continue each consecutive calendar day thereafter until the deficiencies noted have been corrected to the complete satisfaction of the Engineer.

212.03.4 Failure of Erosion and Pollution Controls. This **SECTION 212; MAINTENANCE AND CLEANING OF EROSION AND POLLUTION CONTROLS**, is based on the concept that erosion and pollution controls will essentially remain intact under normal rainfall events and that any damage sustained by said controls under normal rainfall may be repaired under the maintenance provisions set forth herein.

However, under abnormal weather events it is possible that erosion and pollution controls may be damaged to the extent that the Engineer may direct that they be replaced in their entirety. Under such abnormal conditions the Contractor will replace the particular facilities, and be compensated for same, under the applicable provisions of **SECTIONS 206, 207, 208, 209 and 210; PERIMETER CONTROLS, CHECK DAMS, TEMPORARY DEWATERING BASINS, STORM DRAIN PROTECTION, and STILLING BASINS,** respectively, of these Specifications.

a. Abnormal Weather Conditions. For the purposes of this **Subsection 212.03.4**, abnormal weather events are defined as follows:

1. For a duration of 1 hour; rainfall equal to or greater than ½-inch.

2. For a duration of 12 hours; rainfall equal to or greater than 2 inches.

3. For a duration of 24 hours; rainfall equal to or greater than 3 inches.

4. Extreme weather conditions such as hurricanes, tornadoes, floods, blizzards, etc.

Daily rainfall records may be obtained from the National Weather Service.

212.04 METHOD OF MEASUREMENT.

212.04.1 Perimeter Controls, Check Dams, Temporary Dewatering Basins, and Storm Drain Protection. These items do not require a measurement for payment.

212.04.2 Stilling Basins. "Maintenance and Cleaning Stilling Basins" will be measured by the number of such stilling basins actually maintained and cleaned in accordance with the Plans and/or as directed by the Engineer.

212.05 BASIS OF PAYMENT.

212.05.1 Perimeter Controls, Check Dams, Temporary Dewatering Basins and Storm Drain Protection. "Maintenance and Cleaning of Erosion and Pollution Controls" will be paid for at the contract lump sum price as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, and equipment for maintaining and cleaning any and all of the controls so designated, complete and accepted by the Engineer.

212.05.2 Stilling Basins. The accepted quantity of "Maintenance and Cleaning of Stilling Basins" will be paid for at the contract unit price per each as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials and equipment, and all other incidentals required to finish the work, complete and accepted by the Engineer.

SECTION 213

PLACEMENT OF MILLINGS BENEATH GUARDRAIL

213.01 DESCRIPTION. This work consists of the placement of bituminous millings from cold planing operations at all guardrail locations less than 2 feet from the edge of the existing pavement, or as indicated on the Plans, and/or as directed by the Engineer, all in accordance with these Specifications.

213.02 MATERIALS. Millings shall consist of bituminous material removed from the project roadway during cold planing operations and ground or crushed such that 100 percent of the material passes a 1-inch sieve. Millings shall be obtained from stockpiled locations on the project site, and shall be free of debris, topsoil and soil clumps. Millings may not be obtained from off-site sources unless specifically authorized by the Engineer.

213.03 CONSTRUCTION METHODS. The Contractor shall grade beneath the guardrail such that the finish surface of the millings is flush with the bituminous berm or edge of pavement. The millings shall be placed to a point 1 foot behind the guardrail post, and shaped, compacted and sloped to drain away from the pavement. The Contractor will not be allowed to dismantle the guardrail to perform any work associated with this item. The stockpiling of millings shall be restricted to approved, on-site locations, and in no instance will stockpiling of millings be allowed on the roadway shoulder or immediately adjacent to a travel lane.

The Contractor shall use a suitable means to excavate and remove the material beneath the guardrail such that damage to the guardrail does not result, and to place the millings as indicated on the Plans or as directed by the Engineer. All material that is removed from beneath the guardrail, including excess millings, shall be legally disposed of.

213.04 METHOD OF MEASUREMENT. "Placement of Millings Beneath Guardrail" will be measured by the number of linear feet of guardrail for which millings were actually placed in accordance with the Plans and/or as directed by the Engineer.

213.05 BASIS OF PAYMENT. The accepted quantity of "Placement of Millings Beneath Guardrail" will be paid for at the contract unit price per linear foot as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, equipment and tools, including removal and disposal of the existing material, and all other incidentals required to finish the work, complete and accepted by the Engineer.

SECTION 214

CONTAINMENT SYSTEM FOR CONTROL OF HYDRODEMOLITION RUNOFF AND MAINTENANCE AND DISPOSAL OF HYDRODEMOLITION RUNOFF

214.01 DESCRIPTION. This work consists of the provision of an on-site containment system for runoff from hydrodemolition operations, a system which shall provide for the temporary storage of discharge from the hydrodemolition operations, allow for the settlement of suspended materials from the hydrodemolition runoff, and enable the collection of sediments and other materials from the containment system for off-site disposal.

214.02 MATERIALS. Any use of materials not specifically included on the Plans and/or in this Specification shall require the prior approval of the Engineer.

214.03 CONSTRUCTION METHODS. At least thirty (30) days prior to starting hydrodemolition operations, the Contractor shall submit for the Engineer's approval the proposed storage area and maintenance plan for the hydrodemolition runoff. The submission shall consist of two elements: the containment/sedimentation system and the maintenance procedures.

214.03.1 Containment System for Control of Hydrodemolition Runoff. If the project is within the jurisdiction of the Rhode Island Department of Environmental Management (RIDEM) or the Coastal Resources Management Council (CRMC), the containment system must be constructed in accordance with permit conditions and approved plans. Otherwise, the Contractor shall be responsible for obtaining the necessary approvals prior to beginning hydrodemolition activities. Copies of all such approvals shall be provided to the Department.

a. Minimum Requirements. The containment system shall meet the following minimum requirements:

1. It shall be one of the following structures:

(a) An open basin formed of natural topography lined with an impermeable fabric.

(b) An area where excavated material can be placed to form a temporary earth berm, lined with an impermeable fabric.

(c) A manmade, portable structure which can be placed on-site for the duration of the hydrodemolition process.

2. The submittal shall consist of computations accompanied by the hydrodemolition equipment's operating specifications, demonstrating that the sedimentation area is capable of holding the maximum discharge from eight (8) hours of hydrodemolition operations and a minimum of three thousand (3,000) gallons.

3. The containment system shall be located within the available infield(s) of the project, and shall not encroach on the pedestrian or travel ways. The location of the facility shall be surrounded by a temporary snow fence to discourage unauthorized entry.

4. If disturbance of the original soil is required for the establishment of the containment system, a row of haybales shall be placed five (5) feet downslope from the edge of disturbance, and shall remain in place through the hydrodemolition process. Subsequent site restoration shall be required.

214.03.2 Maintenance and Disposal of Hydrodemolition Runoff. The Contractor shall develop a method by which the temporary sedimentation basin is to be maintained, cleaned and emptied prior to the start of any work. No work within areas of RIDEM or CRMC jurisdiction, or which is outside of approved limits of disturbance, will be authorized by the Engineer.

a. Requirements. The disposal of the liquid and solid discharge elements of the hydrodemolition operations shall conform to the following requirements:

1. The Contractor shall not commence hydrodemolition operations on a given workday until the containment system has been cleaned to the satisfaction of the Engineer.

2. Liquid runoff may be removed and discharged in accordance with RIDEM or CRMC approval only after a settling period of not less than six (6) hours. Hydrodemolition runoff may not be discharged into any area of RIDEM or CRMC jurisdiction, or into any storm drain which outfalls to any such area, without prior approval of RIDEM or CRMC. The Contractor shall be responsible for obtaining all such approvals and forwarding copies to the Department. The water may not drain across unpaved surfaces, but shall be pumped, siphoned or conducted along a temporary paved waterway. Haybales shall be required for any process requiring disturbing earth or discharge over unpaved surfaces.

3. Any solid debris collected in the bottom of the basin shall be removed and legally disposed of by the Contractor.

b. Damaged Facilities. The Contractor shall be required to replace, rebuild or repair the basin, or any part thereof, which is damaged or otherwise rendered inoperative to the extent that it does not perform its intended function, at no additional cost to the State. Such efforts include but are not limited to snow fence repair, structure repair, and maintaining haybales.

214.04 METHOD OF MEASUREMENT.

214.04.1 "Containment System for Control of Hydrodemolition Runoff" does not require a measurement for a lump sum payment.

214.04.2 "Maintenance and Disposal of Hydrodemolition Runoff" will be measured by the number of days where actual hydrodemolition takes place in accordance with the Plans and/or as directed by the Engineer.

214.05 BASIS OF PAYMENT.

214.05.1 "Containment System for Control of Hydrodemolition Runoff" will be paid for at the contract lump sum price as set forth in the Proposal. The price so-stated constitutes full compensation for establishing a suitable sedimentation basin for the hydrodemolition runoff, all materials, labor, tools, equipment, and earthwork associated with providing the basin, erosion control, snow fence, removal of all materials and restoration of all ground surfaces disturbed in the installation and operation of the system, and all other incidentals necessary for the proper completion of the work specified and shown on the Plans, complete and accepted by the Engineer.

214.05.2 "Maintenance and Disposal of Hydrodemolition Runoff" will be paid for at the contract unit price per day as listed in the Proposal. The price so-stated constitutes full compensation for transportation and disposal of the hydrodemolition wastewater, all materials, labor, tools, vehicles, any necessary permits and approvals required to complete the disposal, and all other incidentals necessary for the proper completion of the work specified and shown on the Plans, complete and accepted by the Engineer.

PART 300

AGGREGATE AND GRAVEL BASE AND SUBBASE COURSES

SECTION 301

AGGREGATE AND GRAVEL BASE COURSES

301.01 DESCRIPTION. This work consists of providing one or more courses of graded aggregate or gravel borrow and fillers, if required, on prepared subgrade surfaces in reasonable close conformity with the dimensions and details indicated on the Plans, all in accordance with these Specifications.

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

a. **Gravel Borrow; Subsection M.01.09; Table I, Column I.**
b. **Crushed Stone or Gravel; Subsection M.01.09; Table I, Column II.**
c. **Fillers; Subsection M.01.08, Fine Aggregate.**

301.03 CONSTRUCTION METHODS.

301.03.1 Placing. If the required compacted depth of the base course exceeds 12 inches, the base shall be constructed in two or more layers of approximate equal thickness. The maximum compacted thickness of any one layer shall not exceed 12 inches. The maximum size of stone in the gravel borrow or aggregate placed, shall not exceed 3/4ths of the depth of the layer after compaction. This restriction determines the maximum size of stone in the gravel borrow specification of **Subsection M.01.09; Gradation of Aggregate**.

301.03.2 Shaping and Compaction. Compaction of each layer shall continue until a density of not less than 95 percent of the maximum density determined in accordance with AASHTO T180 has been achieved. The surface of each layer shall be maintained during the compaction operations in such a manner that a reasonable uniformity is produced. The compacted surface shall have a tolerance of ½-inch, plus-or-minus, to the grades shown on the Plans or as directed. However, no plus or minus deviation may continue for more than 100 feet in any direction.

301.04 METHOD OF MEASUREMENT. "Aggregate Base Course" and/or "Gravel Borrow Base Course" will be measured by the number of cubic yards or the number of tons, as the case may be, actually in place in accordance with the Plans and/or as directed by the Engineer.

301.05 BASIS OF PAYMENT. The accepted quantities of "Aggregate Base Course" and/or "Gravel Borrow Base Course," will be paid for at the respective contract unit prices per ton or cubic yard, as the case may be, as listed in the Proposal. The prices so-stated shall constitute

full and complete compensation for all labor, materials, and equipment, and all other incidentals required to finish the work, complete and accepted by the Engineer.

SECTION 302

GRAVEL BORROW SUBBASE COURSES

302.01 DESCRIPTION. This work consists of providing one or more courses of gravel borrow on prepared subgrade surfaces in reasonably close conformity with the dimensions and details indicated on the Plans, all in accordance with these Specifications.

302.02 MATERIALS. Gravel Borrow shall meet the requirements of **Subsection M.01.09; Gradation of Aggregates, Table I, Column I**.

302.03 CONSTRUCTION METHODS.

302.03.1 Placing. Placing subbase materials shall conform to the requirements of **Subsection 301.03.1** of these Specifications.

302.03.2 Shaping and Compaction. Shaping and compaction of subbase materials shall conform to the requirements of **Subsection 301.03.2** of these Specifications.

302.04 METHOD OF MEASUREMENT. "Gravel Borrow Subbase Course" will be measured by the number of cubic yards actually placed in accordance with the Plans and/or as directed by the Engineer.

302.05 BASIS OF PAYMENT. The accepted quantity of "Gravel Borrow Subbase Course" will be paid for at the contract unit price per cubic yard as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, and equipment, and all other incidentals, including trimming and fine grading required to finish the work, complete and accepted by the Engineer.

SECTION 303

SPECIAL GRADED AGGREGATE FOR SHAPING AND TRIMMING DRIVEWAYS OR SHOULDERS

303.01 DESCRIPTION. This work consists of providing special graded aggregate as surface courses for driveways or shoulders to be placed in reasonably close conformity with the lines, grades, and typical cross sections indicated on the Plans, all in accordance with these Specifications.

303.02 MATERIALS. Special graded aggregate shall be a composite mix of crusher run coarse aggregate and fine aggregate, free from clay, loam, soft or elongated rock fragments, organic soil or vegetative matter.

Coarse aggregate (plus No. 4) shall consist of clean, hard, durable particles of crushed rock fragments or crushed gravel. Crushed gravel shall consist of 95 percent by weight particles with at least one fractured face. Coarse aggregates shall have a percentage of wear by the Los Angeles Abrasion Test (AASHTO T96) of not more than 50 percent, and a Sodium Sulfate Soundness (AASHT0 T104) of not more than 12 percent.

Fine aggregate shall consist of particles produced during the crushing of coarse aggregate at the approved source and shall be free of organic deleterious matter.

The composite coarse and fine aggregate mix shall conform to the following gradation requirements:

Square Mesh Sieve Size:	**Percentage by Weight Passing Indicated Square Mesh Sieve:**
1½"	100
1"	85 - 100
½"	50 - 85
No. 4	40 - 75
No. 40	8 - 35
No. 200	2 - 10

Coarse and fine aggregates to be used as Special Graded Aggregate for driveway or shoulder surfaces shall be selected to provide a stable, compactable, functional and presentable surface which shall be similar in color and texture, as approved by the Engineer, to match existing surfaces.

303.03 CONSTRUCTION METHODS.

303.03.1 Placing. When used as a crushed aggregate surface course to provide a transition between existing gravel/aggregate surfaces and new asphalt, special graded aggregate shall be placed in layers such that the maximum compacted thickness of any one layer shall not exceed 6 inches.

303.03.2 Shaping and Compaction. Special graded aggregate shall be shaped and compacted in accordance with the requirement of **Subsection 301.03.2; Shaping and Compaction**, of these Specifications.

303.04 METHOD OF MEASUREMENT. "Special Graded Aggregate" will be measured by the number of cubic yards or the number of tons, as the case may be, actually placed in accordance with the Plans and/or as directed by the Engineer.

303.05 BASIS OF PAYMENT. The accepted quantity of "Special Graded Aggregate" will be paid for at the contract unit price per ton or per cubic yard, as the case may be, as listed in the Proposal. The price so-stated shall constitute full and complete compensation for all labor, materials, and equipment, including trimming and fine grading, and all other incidentals required to finish the work, complete and accepted by the Engineer.

SECTION 304

SELECT LEVELING AND FILLER AGGREGATE

304.01 DESCRIPTION. This work consists of providing select leveling and filler aggregate to adjust subbase or subgrade surfaces to close conformance with the lines, grades, and typical cross sections indicated on the Plans, all in accordance with these Specifications.

304.02 MATERIALS. Select leveling and filler aggregate shall be a composite of crushed or uncrushed coarse aggregate and natural or crushed fine aggregate, all provided from approved sources. The composite aggregate shall be free of compressible or organic soils, soft or elongated rock fragments or gravel, and vegetative matter.

Coarse aggregate (plus No. 4) may consist of crushed rock fragments, crushed or uncrushed gravel, or a blend of crushed and uncrushed rock and gravel. Each coarse aggregate component source material shall have been shown individually to have a percentage of wear by Los Angeles Abrasion Test (AASHTO T96) of not more than 50 percent, and a Sodium Sulfate Soundness (AASHTO T104) of not more than 12 percent.

Fine aggregate may consist of natural sand or particles produced by crushing rock or gravel, and shall be free of organic soils or other deleterious matter.

The composite coarse and fine aggregate mix shall conform to the following gradation requirements:

Square Mesh Sieve Size:	Percentage by Weight Passing Indicated Sieve Size:
1½"	100
1"	70 - 100
3/4"	50 - 85
3/8"	40 - 75
No. 4	30 - 55
No. 40	0 - 25
No. 200	0 - 8

304.03 CONSTRUCTION METHODS.

304.03.1 Surface Preparation. The existing subbase or subgrade surface shall be scarified to a depth of 3 inches prior to placement of the select aggregate as a filler for local depressions or washouts, or as a leveling course.

304.03.2 Placement. Select leveling and filler aggregate shall be placed in layers such that the maximum compacted thickness of any one layer shall not exceed 6 inches.

304.04 METHOD OF MEASUREMENT. "Select Leveling and Filler Aggregate" will be measured by the number of cubic yards actually placed in accordance with the Plans and/or as directed by the Engineer.

304.05 BASIS OF PAYMENT. The accepted quantity of "Select Leveling and Filler Aggregate" will be paid for at the contract unit price per cubic yard as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials and equipment, including trimming and fine grading and all other incidentals required to finish the work, complete and accepted by the Engineer.

PART 400

BITUMINOUS PAVEMENTS

SECTION 401

DENSE GRADED BITUMINOUS CONCRETE PAVEMENTS

401.01 DESCRIPTION. These Specifications are applicable to all types of bituminous pavements irrespective of gradation of aggregate, kind and amount of bituminous material, or pavement use.

This work consists of constructing base, binder, or surface courses of bituminous concrete pavement on prepared foundations in reasonably close conformity with the dimensions and details indicated on the Plans, all in accordance with these Specifications.

401.01.1 Specific Pavements and Mixes. The specific pavements and mixes are designated by the column headings of the table that constitutes **Subsection M.03.01** of these Specifications. They are:

a. Base Course
b. Binder Course
c. Bridge Binder
d. Surface Course; Class I-1
e. Surface Course; Class I-2, or Sidewalks.

401.02 MATERIALS.

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

401.02.2 Filler. Filler shall meet the requirements of **Subsection M.03.02.3** of these Specifications.

401.02.3 Hydrated Lime. Hydrated lime shall meet the requirements of **Subsection M.04.03.4** of these Specifications.

401.02.4 Bituminous Materials. The grade of bituminous material shall be as specified in **Subsection M.03.02.1** of these Specifications. Performance graded PG 64-28 shall be used in all non-recycled paving mixtures, including friction courses, unless otherwise approved by the Engineer. Asphalt cement will be conditionally accepted at the point of distribution and at the point of use on the basis of a certificate of analysis. Samples will be taken at the plant and tested by the Engineer to determine specification conformance.

401.02.5 Composition of Mixtures. The bituminous concrete shall be composed of a mixture of aggregate, filler, if required, and bituminous material. The aggregate shall be sized, graded and combined in such proportions that the resulting mixture meets the grading requirements of the job mix formula.

The Contractor annually shall submit for the Engineer's approval, a job mix formula, including aggregate sources and mixing temperature, for each mixture to be supplied by each plant. The job mix formula with the allowable tolerances shall be within the master ranges specified in **Subsection M.03.01** for the particular type of bituminous concrete. The job mix formula for each mixture shall be in effect until the Engineer is notified in writing of any modifications and approves the new mix. The job mix formula for each mixture shall establish a single percentage of aggregate passing each required sieve size, and a single temperature at which the mixture is to be delivered at the point of discharge.

a. Determination of Optimum Asphalt Cement Content for Asphaltic Concrete Mixtures. The Contractor shall be responsible for the complete laboratory design of all asphalt concrete mixtures. The aggregate and the job mix formulas used in all design procedures shall be those approved for the mixture.

b. Mix Design Procedures. The procedures of the Asphalt Institute publication "Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types" (MS-2) Marshall Method of Mix Design (latest edition) shall be followed in the preparation and testing of the specimens and determination of the optimum asphalt content, with the following exceptions:

1. Equivalent AASHTO test methods shall be substituted for all ASTM test methods referenced in MS-2.

2. The mixing temperature and number of blows applied to each side of each specimen shall be as specified in the Table of **Subsection M.03.01; Bituminous Concrete Pavements**, of these Specifications.

3. For the voids analysis, the Theoretical Maximum Specific Gravity shall be determined at each asphalt content. Samples of the minimum size specified in AASHTO T-209 shall be submitted at each asphalt content.

4. The data shall include a plot of Voids Filled with Asphalt vs. Asphalt Content.

5. All mix designs submitted shall include an ignition furnace calibration factor.

6. At the optimum asphalt content, the properties of the mix shall satisfy all specified requirements, including those specified in the Table of **Subsection M.03.01; Bituminous Concrete Pavements**, of these Specifications.

All design data and calculations shall be signed by a Registered Professional Engineer and must be submitted to the Materials Section no later than two weeks before production of that mixture is scheduled to begin. No mixture may be produced for State projects until the mix design is approved by the Engineer.

c. Job Mix Tolerances. After the job mix formula and optimum asphalt content are established, all bituminous mixtures produced shall conform to the following range of tolerances and the master ranges specified in Table M.03.01:

Passing No. 4 and larger sieves:	plus or minus 7 percent
Passing No. 8 to No. 100 sieves:	plus or minus 4 percent

Passing No. 200 sieve:	plus or minus 2 percent
Asphalt Content:	plus or minus 0.3 percent
Temperature of mixture	plus or minus 20°F

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.

The aggregate will be accepted, on the basis of its source and quality, in stockpile at the plant site. The plant mixed material will be accepted after blending and mixing at the plant. Final acceptance will be based on satisfactory quality of material after placement, providing that it meets all Contract requirements.

401.02.6 Quality Control.

a. Process Control. The Contractor shall exercise process control over all production operations. This will entail the constant monitoring of equipment, materials, and production activity to insure that bituminous mixtures meet all applicable requirements and are produced within the allowable tolerances. The Contractor shall be responsible for conducting any tests and making any analysis necessary to make certain that all mixtures are produced within the limits of the Specifications.

The Contractor has the option of using the acceptance test results as part of its process control.

b. Acceptance Testing. Acceptance testing will be conducted in the plant field laboratory by the Engineer.

The results of an acceptance test are satisfactory only when all specification requirements are met. Neither the asphalt content nor the percent passing any sieve may vary from the mix design by more than the specified job mix tolerance. The Engineer will notify the Contractor of any unsatisfactory acceptance test result. Another acceptance test will be performed as soon as it is possible to sample mix produced after the Contractor has been given sufficient time to take corrective action. In no case will this be longer than the maximum prescribed acceptance testing interval.

The Contractor shall cease production and delivery of any class of mix for the following reasons:

1. The asphalt content or the percent passing any individual sieve varies from the mix design by more than twice the specified job mix tolerance in any single acceptance test.

2. Either the asphalt content or the aggregate gradation exceeds the job mix tolerance on both of two consecutive acceptance tests on the same class of mix.

3. The results of three acceptance tests within a 24-hour period on the same class of mix are unsatisfactory for any reason or combination of reasons.

4. Production of that class of mix will be allowed to resume on that day or on any succeeding day only after completion of a successful trial batch and it has been demonstrated to the satisfaction of the Engineer that material can be produced consistently and within specification.

Failure to meet requirements will be cause for rejection by the Engineer of the non-conforming material produced.

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

401.03 CONSTRUCTION METHODS.

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

Plants producing bituminous concrete for State of Rhode Island paving projects including new construction, resurfacing, and maintenance shall conform to the following requirements:

a. Requirements for All Plants.

1. Equipment for Preparation of Bituminous Material. Tanks provided for the storage of bituminous material 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 bituminous material 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 insure the safe and proper sampling of the liquid asphalt.

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. 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. Bituminous Control Unit. Satisfactory means, either by weighing or metering, shall be provided to obtain the proper amount of bituminous material in the mix within the tolerance

specified. Means shall be provided for checking the quantity or rate of flow of bituminous material into the mixer.

6. Thermometric Equipment. An armored thermometer of adequate range in temperature reading shall be fixed in the bituminous 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 bituminous mixture 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 stairways 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 and unobstructed passage shall be maintained at all times in and around the truck loading area. This area shall be kept free from drippings.

11. Hot Bituminous Mixture Holding Bin. Hot bituminous mixtures may be stored in holding bins especially designed for that purpose. Each holding bin must meet the requirements of AASHTO M156, unless otherwise permitted by the Engineer, and will 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. Bitumen 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 bitumen in batch.

(d) Weight of total batch.

(e) Total weight of batches in truck.

(f) Total weight of bitumen 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 trucker and truck number.

(l) Mixture.

(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 bituminous materials 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 insure uniform and continuous operation shall be provided. The bins shall be arranged to insure 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
Asphalt:	±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 bituminous material 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 bituminous material. The wet mixing period is the interval of time between the commencement of application of the bituminous material 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. Bituminous Control. The equipment used to measure the bituminous material shall be accurate to plus or minus 0.5 percent. The bituminous material 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 bituminous material 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 bituminous scales. The capacity of the bituminous material bucket shall be at least 15 percent in excess of the weight of bituminous material required in any batch. The plant shall have an adequately heated quick-acting, non-drip, charging valve located directly over the bituminous material bucket.

The indicator dial shall have a capacity of at least 15 percent in excess of the quantity of bituminous material 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 bituminous material to each batch. The dial shall be in full view of the mixer operator. The flow of bituminous material shall be automatically controlled so that it will begin when the dry mixing period is over. All of the bituminous material 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 asphalt bucket shall provide a uniform application of bituminous material the full length of the mixer. The section of the bituminous line between the charging valve and the spray bar shall be provided with a valve and outlet for checking the meter when a metering device is substituted for a bituminous material 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 asphalt 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 asphalt delivery system. Satisfactory means shall be provided to assure positive interlocking control between each cold bin, the cold aggregate feeder, and the asphalt 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 asphalt 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 asphalt, and the cumulative weights of dry aggregate and of asphalt 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.

(d) Type of mixture.

(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 bituminous materials 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 bituminous mixture 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 bitumen.

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

The asphalt 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 asphalt shall be ±0.2 percent of the total mixture weight.

7. Plant Calibration. The cold feed and asphalt 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 hot bituminous mixture 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 bituminous mixtures 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 bituminous material. Any hauling equipment not complying with these Specifications shall be immediately rejected along with its load of bituminous material. 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 assure delivery of the mixture at the specified temperature.

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 set by the Engineer.

Bituminous 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 bituminous plant mixed material 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 bituminous concrete material 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 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 and screed extenders shall be heated if necessary to maintain the bituminous mixture at the required placement temperature.

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 of not less than 30 feet in length. The sensor shall also have the capability of operating from a reference line unless the ski-type device can ride on an adjacent, newly placed lift of bituminous concrete. 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.

Whenever a breakdown or malfunction of the automatic controls occurs, the equipment may be operated manually or by other methods for the remainder of the normal working day on which the breakdown or malfunction occurred provided this method of operation will produce results otherwise meeting project requirements.

401.03.4 Rollers. Static or vibratory steel wheel rollers or pneumatic tire rollers shall be employed. They shall be in good condition, capable of reversing without backlash, and shall be operated at speeds slow enough to avoid displacement of the bituminous mixture. However, in no case shall such rollers be operated at speeds in excess of five miles per hour.

Vibratory rollers shall have separate controls for energy and propulsion and shall be acceptable for bituminous mixture compaction.

One roller used for compaction shall be equipped with an infrared thermometer with remote sensor that will continuously indicate the temperature of the pavement and be visible to the operator during the rolling process.

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

When a tack coat is required, the type and grade of bituminous material 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.

After a tack coat is applied, no bituminous mix shall be placed on it until the emulsion has broken. The tack coat shall be applied only as far in advance of the placing of mix as is necessary to obtain the proper condition of tackiness.

401.03.6 Preparation of Bituminous Material. The bituminous material shall be heated to the specified temperature in a manner that will avoid local overheating and provide a continuous supply of the bituminous material to the mixer at a uniform temperature at all times.

401.03.7 Preparation of Aggregates. The aggregates for the mixture shall be dried and heated to the required temperature. Flames used for drying and heating shall be properly adjusted to avoid damage to the aggregate and to avoid soot on the aggregate.

In batch type plants, immediately after heating and drying, the aggregates shall be screened into two or more fractions as necessary and conveyed into separate compartments ready for batching and mixing with bituminous material.

401.03.8 Mixing. The dried aggregates shall be combined in the mixer in the amount of each fraction of aggregates required to meet the job mix formula. The bituminous material shall be

measured or gauged and introduced into the mixer in the amount specified by the job mix formula.

In batch type plants, the aggregates shall be mixed dry for a period of five (5) seconds; the asphalt cement shall then be added and mixing continued for a minimum total time of forty-five (45) seconds or as directed or established by the Engineer.

The temperature of the mixture shall be that established and approved by the job mix formula. The measurement of the mixing temperature shall be made as soon as possible after completion of the mixing cycle.

401.03.9 Spreading and Finishing. The mixture shall be laid upon an approved cleaned surface, spread and struck off to the grade and elevation established. Bituminous 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 hot mix asphalt as outlined in Asphalt Institute Publication MS-22, "Construction of Hot Mix Asphalt Pavements" shall be adhered to unless otherwise permitted by the Engineer.

The maximum compacted lift thickness shall be 2 inches for surface courses and 3 inches for any other courses.

Excessive and unnecessary walking on the uncompacted bituminous 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 bituminous pavement 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 bituminous pavement, i.e., surface, binder, or base course, 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. The practice of placing pavement on side streets after the main roadway has been paved results in cold joints at the gutter line and, therefore, such practice is not acceptable.

a. Bituminous Overlay - Bridge Binder. When a bridge binder course is being placed on a surface which is covered with a waterproofing membrane, the following precautions should be observed:

1. No traffic other than paving equipment should 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 asphalt concrete 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 should be repaired immediately. Vehicle tires shall be clean of any rocks or materials that would puncture the membrane.

4. The paving trucks are not to be pushed with the paver.

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

401.03.10 Compaction. Immediately after the bituminous mixture 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 shall be 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 manufacturer's rating of ten tons or greater. The use of equipment which results in excessive crushing of the aggregate will not be permitted.

The sequence of rolling operations and the selection of roller types shall be such as to obtain the required density. Unless otherwise specified, the minimum acceptable density shall be 95 percent of the corresponding daily plant Marshall density (AASHTO T245).

Density measurements shall be made with a nuclear density gauge. In the event of a dispute as to the credibility of the results, the density shall be determined from cores taken from the pavement.

The rolling of a bridge binder course shall begin when the temperature of the mat is not more than 240°F. The ideal temperature for initial compaction of all other types of hot mix is 275°F. Final compaction shall be completed before the temperature of the mat drops below 175°F. The typical time that shall elapse between spreading and completion of the rolling process shall not normally exceed fifteen minutes. This time limit may be modified by the Engineer depending on temperature conditions, but under no circumstances will rolling be allowed when the temperature of the material is less than 175°F.

The speed of a static weight, steel wheel roller, pneumatic tire roller, or vibratory roller shall not exceed five miles per hour.

Rollers shall not be temporarily parked on hot mix. When reversing direction, the action should be smooth, not abrupt. The drive wheel should 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.

Unless otherwise directed, rolling shall start longitudinally at the sides and gradually progress toward the center of the pavement, except on super-elevated curves where the rolling shall begin on the low side and progress to the high side, overlapping on successive trips by at least one-half the width of tandem rollers and uniformly lapping each preceding track.

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 be required to 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 with the surrounding area. Any area showing an excess or deficiency of bituminous material shall be removed and replaced.

401.03.11 Joints. Placing of the bituminous paving shall be as continuous as possible. Rollers shall not pass over the unprotected end of a freshly laid mixture unless authorized by the Engineer.

Longitudinal and transverse joints shall be made in a careful manner. Well bonded and sealed joints are required. 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. Joints between old and new pavements, or between successive days' work, shall be carefully made in such a manner as to insure a thorough and continuous bond between the old and new surfaces. The edge of the old pavement or previously placed new pavement, shall be cut back a sufficient distance to expose a fresh, full thickness, vertical face. To obtain a well bonded joint, this face shall be brush-painted or pressure sprayed with a bituminous tack coat, after which the hot bituminous mixture shall be placed in contact with it. Any bituminous material that falls on the cold side of the mat during paving operations shall be raked onto the hot joint. Care shall be taken to insure that the material pushed onto the hot side of the joint remains in the joint area and is not broadcast over the pavement. The edge of a newly placed pavement that has not been opened to traffic need not be cut back but will require tack coat.

Immediately after compaction, the surface tolerance adjacent to each transverse cold joint shall be tested by placing an approved 10-foot straightedge perpendicular to the cold joint such that the midpoint of the straightedge rests on the cold joint. The variation of the surface from the

testing edge of the straightedge at any point between contacts with the surface shall not exceed 1/4-inch.

401.03.12 Pavement Samples. When specified, 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 with the surrounding area.

401.03.13 Surface Tolerances. The surface will be tested by the Engineer 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.

401.03.14 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.

401.03.15 Weather Limitations. Bituminous concrete shall not be placed on any wet surface, or when weather conditions otherwise prevent the proper handling or finishing of the bituminous mixtures.

a. Restrictions. Bituminous concrete paving may not be placed under any of the following conditions:

1. When the underlying layer contains frozen moisture.

2. When the temperature of the underlying layer, in the shade and away from any source of heat, is below 32°F.

3. When the temperature of the underlying layer, in the shade and away from any source of heat, is below 34°F and the thickness of the lift to be placed is 1½ inches, or less.

b. Compaction. Rollers shall follow pavers as close as possible to provide the specified compaction. Should additional rollers be required, they will be provided in a timely manner. Specification density shall be achieved before the mix temperature drops below 175°F.

401.03.16 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 bituminous binder course has been placed and striped with temporary pavement markings.

401.03.17 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 bituminous 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 hot mix asphalt 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 bituminous 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.

In each case, at the end of a working day, either the pavement removal operations or the pavement overlay operation must be left in a "squared-off" condition, or approximately perpendicular to the direction of traffic.

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 5 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 10 feet horizontal to 1 inch vertical.

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

The Contractor shall place one W8-1 (30" x 30") "BUMP" sign 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 bituminous tack coat, after which the bituminous paving may resume.

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

401.04 METHOD OF MEASUREMENT.

401.04.1 Measurement of Bituminous Concrete Pavement. Bituminous Concrete Pavements, will be measured by the number of tons actually placed in accordance with the Plans and/or as directed by the Engineer. As an alternative, batch weights may be used for measurement so long as the automatic proportioning and recording equipment provisions of **Subsection 401.03.1; Bituminous Mixing Plants**, are satisfied. In such case the cumulative weight of all the batches will be used for payment.

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

Prior to the determination of thickness, the roadway shall exhibit acceptable workmanship and all defects shall have been corrected. The thickness of the total asphalt concrete pavement will be determined by cutting or coring holes to full depth. At least two cores will be taken from each lane mile, except that there will be a minimum of ten cores per 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 Bituminous 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 six feet or greater will be considered to be a separate lane of the roadway. A shoulder width of less than six feet will be considered part of the adjacent lane. The Contractor shall fill any holes cut or cored in the pavement by the Department with a compacted, dense bituminous hot mix material 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 following definitions shall apply:

1. Bituminous Base Course. Base course shall be as indicated on the Plans.

2. Surface Course. The surface course shall consist of bituminous concrete constructed on a prepared base in accordance with these Specifications and in conformity with the lines, grades, thickness and typical cross sections shown on the Plans. For these measurements the binder course shall be considered part of the surface course.

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

(a) The total asphalt concrete 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 10 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 asphalt concrete 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 10 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 (Class I-1) 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 by Marshall core (AASHTO T245) densities using the accepted job mix formula.

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 401.03.5; Conditioning of Existing Surface**, will be paid for at the contract unit prices for the material used.

401.05 BASIS OF PAYMENT. The accepted quantities of the various types of "Bituminous Pavements" i.e., Base Courses, Binder Courses, and Surface Courses, will be paid for at their respective contract unit prices per ton as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, materials and equipment, and for all other incidentals required to finish the work, complete and accepted by the Engineer.

SECTION 402

FRICTION COURSES

402.01 DESCRIPTION. This work consists of placing a friction course on prepared, sound, dense surfaces of bituminous concrete at the locations and to the thickness indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

402.01.1 Specific Pavements. The specific pavements and mixes are designated by the column headings of the table that constitutes **Subsection M.03.01** of these Specifications. They are:

a. Dense Friction Course
b. Ramp Friction Course

402.02 MATERIALS.

402.02.1 Composition. The friction course shall consist of aggregate mixed with asphaltic cement in a bituminous hot mix plant.

402.02.2 Mixture.

a. Approval. Each year dense friction course is to be produced at the hot mix plant, either a new mix design shall be submitted or, at the discretion of the Engineer, the current mix design shall be verified.

b. Mix Design. The Contractor shall submit a mix design for the specific pavements. The design, with the allowable tolerances, shall be within the master range indicated for gradation; percent asphalt; Marshall Stability; percent voids; and flow, all as set forth in the Table that constitutes **Subsection M.03.01** of these Specifications for each particular friction course.

1. Mix Tolerances

Passing 3/8"and larger sieves:	± 7 percent
Passing No. 4 to No. 50 sieves:	± 4 percent
Passing No. 200 sieve:	± 2.0 percent
Asphalt content:	+ 0.2 percent to -0.3 percent

The mix design shall be submitted at least six weeks prior to production.

c. Verification of Mix Design. Sufficient amounts of aggregate and asphalt cement (with additives) shall be submitted to the Engineer at least one month prior to production for the purposes of mix design verification.

The materials used in the mix design will be those approved for the plant at which the friction course is to be produced.

d. Plant Trial Batches. Plant trial batches will be required at the design asphalt content.

402.02.3 Aggregate. Aggregate must be sound, durable and of high quality which includes being resistant to polishing, degradation, and stripping or loss of strength when incorporated in the mix and exposed to water. The aggregate must be from an approved source meeting the criteria stated herein:

a. Coarse Aggregate shall be either crushed ledge stone, crushed granite, or crushed gravel but no combination, blend, or mixture of these will be permitted. It shall have at least 95 percent by weight crushed particles with one or more fractured faces, and 90 percent by weight crushed particles having at least two fractured faces. Coarse aggregate shall also have a loss on abrasion of no more than 40 percent as tested in accordance with AASHTO T96.

1. Crushed gravel is defined as the product of crushing material that is retained on the ¾-inch sieve.

2. The retained coating of coarse aggregate shall be at least 95 percent when tested in accordance with AASHTO T182.

b. Fine Aggregate shall be crushed stone screenings, natural sand, or a blend thereof. No more than 20 percent of the fine aggregate may be natural sand.

c. Aggregate Stockpiles from approved sources shall be available at the plant site no later than two days prior to production for verification testing by the Engineer.

402.02.4 Asphalt Cement. The asphalt cement shall be PG 64-28. It shall contain an approved silicone additive in quantities of 1 ounce per 5,000 gallons of asphalt cement.

To provide adequate stripping resistance, the asphalt cement shall be blended with an approved anti-stripping compound (100 percent active). The dosage level shall be as recommended by the manufacturer. The anti-stripping compound shall be heat stable and capable of remaining in storage indefinitely.

402.03 CONSTRUCTION METHODS.

402.03.1 General Requirements. The mixing, placing and finishing of bituminous friction course shall conform to the applicable requirements of **Subsection 401.03** of these Specifications, together with the following exceptions and additional conditions:

a. Both the mixing temperature and the temperature of the friction courses at the time of placement shall be within the range of 240°F to 280°F.

b. The plant shall operate solely for the production of this mixture and exclusively for the State of Rhode Island. The unloading of silos must commence within one hour from the time loading begins, and silos must be completely emptied within one hour from the time they are filled. The use of silos for storage will not be permitted.

c. The mixture shall be compacted to the required density with adequately ballasted static steel wheel rollers. Adequately ballasted vibratory rollers may be allowed provided they are used in the static mode.

d. The mixture shall be placed as soon as possible after completion of mixing at the plant. It shall be placed within 90 minutes from the time it is loaded in the truck, subject to the specified placement temperature range.

402.03.2 Production and Placement. When placed on a newly reconstructed surface, the thickness shall be as shown on the Plans with a tolerance of ±¼ inch. When used to overlay an existing roadway, the thickness shall be minimum of 1 inch and a maximum of 1¾ inches to accommodate for rut depths of up to ¾ inch on the existing pavement.

The surface on which the friction course is to be placed shall be treated with a tack coat. Tack coat must be applied uniformly over the surface of the underlying pavement. It may be diluted up to 50 percent with water during the manufacturing process. The surface shall be broom cleaned before the application of tack coat. The application rate shall be 0.03 ±.01 gallons per square yard.

Spreading of the mixture shall be performed carefully and the operation shall be as continuous as possible. Particular attention shall be given to the joints and any irregularities shall be removed before compacting.

After placement, the mixture shall be thoroughly and uniformly compacted with power rollers as directed by the Engineer. Sufficient rollers shall be furnished to handle the output of the plant. Rolling shall continue until all roller marks are eliminated, the surface is of uniform texture and true to grade and cross section.

When friction course is placed, compaction with a static steel wheel roller shall be accomplished immediately after lay down when the temperature of the layer is 240°F ±20°F. Over-rolling or rolling when the material is too cool should be avoided so as not to crush the aggregate. In-place density shall be a minimum of 96 percent of Marshall density as determined at the plant. Density shall be attained before the temperature of the surface falls below 175°F.

Excess concentrations of asphalt can be easily detected during paving operations. All "fat" areas shall be removed immediately. The wasted quantity, as determined by the Engineer, shall be subtracted from the quantity shipped that day.

402.03.3 Weather Limitations. Friction course shall not be placed on a wet or damp surface or when the temperature of the surface course, in the shade, is less than 40°F, measured prior to placement. It shall only be placed when the air temperature, in the shade, is at least 40°F and rising.

402.03.4 Time Limitation. Friction course shall only be placed between the period of June 1st to August 31st.

402.04 METHOD OF MEASUREMENT.

402.04.1 Dense Friction Course. "Dense Friction Course" will be measured by the number of tons actually placed in accordance with the Plans and/or as directed by the Engineer.

402.04.2 Ramp Friction Course. "Ramp Friction Course" will be measured by the number of tons actually placed in accordance with the Plans and/or as directed by the Engineer.

402.04.3 Ten Percent Limitation. Pavement thickness will be considered acceptable when placed within the tolerances specified. The total tonnage delivered and placed shall not exceed the tonnage calculated from the approved areas measured from the final surface course width, by the project length, and the pavement thickness in the Contract, by more than 10 percent.

A thicker pavement may be acceptable; however, no payment shall be made for any quantity of asphalt concrete delivered which exceeds 110 percent of the final measured length, times measured width, times specified thickness, times unit weight.

402.05 BASIS OF PAYMENT. The accepted quantities of "Dense Friction Course" and "Ramp Friction Course" will be paid for at their respective contract unit prices per ton as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, materials and equipment and all other incidentals required to finish the work, complete and accepted by the Engineer.

SECTION 403

ASPHALT EMULSION TACK COAT

403.01 DESCRIPTION. This work consists of furnishing, delivering, and placing a liquid asphalt tack coat on bituminous concrete or Portland cement concrete, prior to the placement of a bituminous concrete overlay, all in accordance with these Specifications.

403.02 MATERIALS. The asphalt emulsion shall be SS-1, SS-1h, CSS-1, or CSS-1h.

403.03 CONSTRUCTION METHODS.

403.03.1 Equipment. Application of the asphalt emulsion tack coat shall be by means of a pressure distributor capable of producing a uniform continuous fine spray, through multiple nozzles, resulting in a uniform continuous coat of asphalt emulsion over the section to be treated. Any puddles of tack coat must be squeegeed or broomed out.

403.03.2 Application of Bituminous Material.

a. Application Rates. The asphalt emulsion shall be applied at the following rates over the entire area to be overlayed:

1. Old Pavement. The application rate shall be 0.08 gallons per square yard, plus-or-minus 0.02 gallons per square yard.

2. New Pavement.

(a) Thirty days old or has been opened to traffic: The application rate shall be 0.06 gallons per square yard, plus-or-minus 0.02 gallons per square yard.

(b) Less than thirty days old and has not yet been opened to traffic: Tack coat is not required.

b. Nozzle Settings. Tack coat shall be applied using the proper nozzle settings and the "double coverage" or "triple coverage" techniques as outlined in Chapter 5 of Asphalt Institute Publication MS-22, "Construction of Hot Mix Asphalt Pavements."

c. Additional Requirements. Special care shall be taken at gore areas to insure that asphalt emulsion is not sprayed or tracked onto precast reflectorized gore markers. This shall be accomplished by placing a covering over the gore markers, anchored in place prevent any displacement.

403.04 METHOD OF MEASUREMENT. "Asphalt Emulsion Tack Coat" will be measured by the number of square yards actually spread in the designated area(s) and at the specified rate, all in accordance with the Plans and/or as directed by the Engineer.

403.05 BASIS OF PAYMENT. The accepted quantity of "Asphalt Emulsion Tack Coat" will be paid for at the contract unit price per square yard as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, and equipment, and all other incidentals required to finish the work, complete and accepted by the Engineer.

SECTION 404

PRIME COAT

404.01 DESCRIPTION. This work consists of treating an existing gravel surface with bituminous material, and blotter material, if required, in preparation for receiving a subsequent bituminous course, at the locations indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

404.02 MATERIALS.

404.02.1 Bituminous Materials. Bituminous material used as prime coat may be any of those enumerated in **Subsection M.03.03** of these Specifications. They are:

a. Asphalt Cement; Subsection M.03.03.1

b. Medium Cure Cut-Back Asphalt; Subsection M.03.03.2

c. Rapid Curing Cut-Back Asphalt; Subsection M.03.03.3

d. Emulsified Asphalt; Subsection M.03.03.4

The grade may be changed as required by the Engineer during construction at no change in unit price.

404.02.2 Blotter Material. Blotter material shall meet the requirements of **Subsection M.01.08; Fine Aggregate**, of these Specifications. The material may be accepted in stockpile at the source.

404.03 CONSTRUCTION METHODS.

404.03.1 Equipment. The equipment to be used shall include a power broom, approved broom dragging equipment, rollers, a self-propelled mechanical spreader for spreading coarse aggregate, a mechanical revolving cylinder-type aggregate spreader or mechanical roller-type hopper spreader for spreading fine aggregate that can be so adjusted as to spread accurately the required amount of material per square yard, a bituminous distributor so designed, equipped, maintained, and operated that bituminous material at even heat may be applied uniformly on variable widths of surface up to 15 feet at readily determined and controlled rates from 0.02 to 2.0 gallons per square yard, with uniform pressure. Distributor equipment shall include a tachometer, pressure gauges, sampling valve, accurate volume measuring devices or a calibrated tank, and a thermometer for measuring temperature of tank contents. Distributors shall be equipped with a power unit for the pump and full circulation spray bars adjustable vertically and laterally, and equipment for heating bituminous material. Other types of aggregate spreaders may be used provided they accomplish results equal to those obtained by the types described herein, and are approved.

Rollers shall be self-propelled steel wheel, vibratory or pneumatic type. The number and weight of rollers shall be sufficient to compact the mixture to form a firm, even and unyielding surface.

404.03.2 Preparation of Surface. The surface to be primed shall be shaped to the required grade and section, shall be free from all ruts, corrugations, segregated material or other irregularities and shall be uniformly compacted.

Delays in priming will necessitate reprocessing or reshaping to provide a smooth compacted surface.

404.03.3 Application of Bituminous Material. Bituminous material shall be applied to the width of the section to be primed by means of a pressure distributor in a uniform, continuous spread. When traffic is maintained, not more than one-half of the width of the section shall be treated in one application. Care shall be taken that the application of bituminous material at the junctions of spreads is not in excess of the specified amount. Excess bituminous material shall be squeegeed from the surface. Skipped areas or deficiencies shall be corrected. Building paper shall be placed over the end of the previous applications and the joining application shall start on the building paper. Building paper used shall be removed and satisfactorily disposed of.

When traffic is maintained, one-way traffic shall be permitted on the untreated portion of the roadbed. As soon as the bituminous material has been absorbed by the surface, and blotter material if required, will not pick up, traffic shall be transferred to the treated portion and the remaining width of the section shall be primed.

The quantities, rate of application, temperatures and areas to be treated shall be approved before application of the prime coat.

404.03.4 Application of Blotter Material. If after the application of the prime coat, the bituminous material fails to penetrate within the time specified and the roadway must be used by traffic, blotter material shall be spread in the amounts required to absorb any excess bituminous material.

404.03.5 Weather Limitations. Bituminous material shall not be applied on a wet surface or when weather conditions would prevent its proper construction. Prime coat will not be applied when the air temperature is below 50°F unless otherwise permitted by the Engineer.

404.04 METHOD OF MEASUREMENT.

404.04.1 Bituminous Material. "Prime Coat" will be measured by the number of square yards actually applied in accordance with the Plans and/or as directed by the Engineer.

404.04.2 Blotter Material. "Blotter Material" will be measured by either the number of tons or the number of cubic yards, as the case may be, actually applied in accordance with the Plans and/or as directed by the Engineer.

404.05 BASIS OF PAYMENT.

404.05.1 Prime Coat. The accepted quantities of "Prime Coat" will be paid for at the contract unit price per square yard as listed in the Proposal.

404.05.2 Blotter Material. The accepted quantity of "Blotter Material" will be paid for at the contract unit price per ton or per cubic yard, as the case may be, as listed in the Proposal.

The prices so-stated constitute full and complete compensation for all labor, materials, and equipment, and all other incidentals required to finish the work, complete and accepted by the Engineer.

SECTION 405

SEAL COAT

405.1 DESCRIPTION. This work consists of providing a surface treatment consisting of an application of bituminous material on a prepared gravel foundation, to be followed by an application of cover coat material, at the locations indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

405.02 MATERIALS.

405.02.1 Bituminous Material. Bituminous material used as a seal coat may be any of those enumerated in **Subsection M.03.03** of these Specifications. The specific material to be used will be specified in the Contract. The grade may be changed by the Engineer during construction at no change in the unit price.

405.02.2 Cover Coat Material. Cover coat material shall meet the requirements of **Subsection M.01.08; Fine Aggregate**, for the size specified. The material may be accepted in stockpile at the source.

405.03 CONSTRUCTION METHODS.

405.03.1 Equipment. The equipment to be employed shall conform to the applicable requirements of **Subsection 404.03.1** of these Specifications.

The aggregate spreader shall be equipped with a means of applying the cover coat material to the surface with positive controls so that the required amount of material will be deposited uniformly over the full width of the bituminous material. Other types of aggregate spreaders may be used provided they accomplish equivalent results and are approved.

405.03.2 Preparation of Surface. Seal coating operations shall not be started until the surface is thoroughly compacted by rolling and traffic.

Bituminous material shall not be applied until the surface has been cleaned as required, and the section to be sealed has been approved.

405.03.3 Applying Bituminous Material. Bituminous material shall be applied by means of a pressure distributor in a uniform, continuous spread over the section to be treated. Bituminous material shall be heated to a temperature in accordance with the manufacturer's recommendations. The quantity of bituminous material to be used per square yard shall be as directed. A strip of building paper, at least 3 feet in width and with a length equal to that of the spray bar of the distributor plus one foot, shall be used at the beginning of each spread. If the cut-off is not positive, the use of paper may be required at the end of each spread. The paper shall be removed and disposed of in a satisfactory manner. The distributor shall be moving forward at proper application speed at the time the spray bar is opened. Any skipped areas or deficiencies shall be corrected. Junctions of spreads shall be carefully made to assure a smooth riding surface.

The length of spread of bituminous material shall not be in excess of that which trucks loaded with cover coat material can immediately cover.

The spread of bituminous material shall not be more than 6 inches wider than the width covered by the cover coat material from the spreading device. Under no circumstances shall operations proceed in such manner that bituminous material will be allowed to chill, set up, dry, or otherwise impair retention of the cover coat.

The distributor, when not spreading, shall be parked so that the spray bar or mechanism will not drip bituminous materials on the surface of the traveled way.

405.03.4 Application of Cover Coat Material. Immediately following the application of the bituminous material, cover coat material shall be spread in quantities as designated. Spreading shall be accomplished in such a manner that the tires of the trucks or aggregate spreader at no time contact the uncovered and newly applied bituminous material.

If directed, the cover coat material shall be moistened with water to eliminate or reduce the dust coating of the aggregate. Moistening shall be done the day before the use of the aggregate.

Immediately after the cover coat material is spread, any deficient areas shall be covered by additional material. Initial rolling shall begin immediately behind the spreader and shall consist of one complete coverage with a power roller. Pneumatic tire rolling shall begin immediately after completion of the initial rolling and shall be continued until 3 complete coverages are obtained. Pneumatic tire rolling shall be completed the same day the bituminous material and cover coat materials are applied.

After the application of the cover coat material, the surface where specified shall be lightly broomed or otherwise maintained as directed. Maintenance of the surface shall include the distribution of cover coat material over the surface to absorb any free bituminous material and cover any area deficient in cover coat material. The maintenance shall be conducted so that imbedded material is not displaced. Excess material shall be swept from the entire surface by means of rotary brooms. The surface shall be swept at the time determined by the Engineer.

405.03.5 Weather Limitations. Bituminous material shall not be applied on a wet surface or when weather conditions would prevent its proper construction. Seal coat will not be applied when the air temperature is below 50°F unless otherwise permitted by the Engineer.

405.04 METHOD OF MEASUREMENT.

405.04.1 Bituminous Material. "Seal Coat" will be measured by the number of square yards actually applied in accordance with the Plans and/or as directed by the Engineer.

405.04.2 Cover Coat Material. "Cover Coat Material" will be measured by either the number of tons or the number of cubic yards, as the case may be, actually applied in accordance with the Plans and/or as directed by the Engineer.

405.05 BASIS OF PAYMENT.

405.05.1 Seal Coat. The accepted quantity of "Seal Coat" will be paid for at the contract unit price per square yard as listed in the Proposal.

405.05.2 Cover Coat Material. The accepted quantity of "Cover Coat Material" will be paid for at the contract unit price per ton or per cubic yard, as the case may be, as listed in the Proposal.

The prices so-stated constitute full and complete compensation for all labor, materials, and equipment, and all other incidentals required to finish the work, complete and accepted by the Engineer.

SECTION 406

COLD RECYCLED BASE COURSE
(PAVEMENT REHABILITATION/RECYCLING)

406.01 DESCRIPTION. This work consists of the rehabilitation of an existing pavement structure into a processed asphalt stabilized base (recycled) course. The existing pavement is to be mixed with a specified depth of the existing gravel base. This mixture of pavement and gravel is to be processed, reshaped, rolled, compacted and fine graded to the cross sections and/or grades indicated on the Plans, all in accordance with these Specifications.

406.01.1 Remaining Gravel Base. The remaining gravel base and/or subgrade may be modified to properly accommodate the processed asphalt stabilized base course. Any modifications of this nature, if required, such as, but not limited to, the excavation and replacement of unsuitable materials and trimming and fine grading will be accomplished under separate bid items. Any movement of the existing recyclable materials to allow for these modifications is included in this bid item.

406.02 MATERIALS. The processed asphalt stabilized base material shall conform to the gradation requirements of either Gradation "A" or Gradation "B," whichever is specified in the Contract.

Sieve Designation	Gradation "A" % Passing by Weight	Gradation "B" % Passing by Weight
3"	100	100
2½"	80-100	100
1½"	70-100	70-100
3/4"	50-85	50-95
NO. 4	30-55	30-75
NO. 50	8-24	8-30
NO. 200	2-12	3-12

If additional aggregate is needed, the Contractor may be directed to add material from an outside source. However, scarified pavement and gravel fines must be mixed together and thoroughly worked and/or reworked as described herein.

Additional gravel shall conform to the requirements for Gravel Borrow as set forth in **Subsection M.01.09, Table I, Column I**, of these Specifications.

406.03 CONSTRUCTION METHODS.

406.03.1 Equipment. The Contractor has the option to utilize whatever equipment can effectively pulverize, crush, mix and/or blend the recyclable materials to specification. Furthermore, the Contractor can either choose to process in-place or load and haul the recyclable materials to an off-site location, process them into the proper recycled material and return it to the job site.

406.03.2 Procedure. Prior to the start of Pavement "Rehabilitation/Recycling" all water and gas gates are to be lowered to a minimum depth of one foot from proposed finish grade. All manholes and catch basin frames, grates and covers are to be removed. The structures are to be covered with a temporary cover which shall overhang the pavement opening by a minimum of one foot on all sides of adequate strength to accommodate truck and construction equipment loadings. The voids remaining after utility gates or drainage structures are lowered are to be filled with gravel borrow material conforming to the requirements of **Table I, Column I** of **Subsection M.01.09** of these Specifications. The existing pavement is to be scarified and mixed with gravel from the roadway structure.

The minimum depth of existing gravel to be incorporated in the rehabilitation process will be shown on the Plans. This quantity will be taken from the uppermost portion of the base layer unless otherwise specified.

Water and calcium shall be added to insure optimum moisture content at the time of compaction. They shall be applied at the rate of 0.25 pounds of calcium chloride per gallon of water per square yard of recycled pavement area. The mixing formula may be modified by the Engineer to compensate for temperature, humidity, weather and/or density determinations.

Any required modifications to the remaining gravel base and/or subgrade such as but not limited to cuts, fills, grade realignment and the removal of unsuitable materials will be made before spreading the asphalt stabilized base material. Existing utility gates, manholes and catch basins are to be adjusted to finish grade.

The thickness of the processed asphalt stabilized (recycled) base course will be shown on the Plans, graded to the specified cross section, plan grades or as directed by the Engineer and compacted to a uniform density of not less than 95 percent of maximum density as determined by AASHTO T180, Method D.

The restored cross section shall be thoroughly compacted to a dense consolidated mass by rolling with an approved roller capable of producing the specified density. The required density will be measured by a Nuclear Density Gauge.

The processed asphalt stabilized base shall be tested for smoothness and accuracy of grade and if any portions are found to lack required smoothness or accuracy such portions shall be re-scarified, reshaped, recompacted, and otherwise manipulated as the Engineer may direct until the required smoothness and accuracy are obtained. The finished surface shall have a tolerance of ½ inch plus or minus to the grades shown on the Plans or as directed.

It is the responsibility of the Contractor to insure that the equipment/construction methods he intends to use are capable of complying with project specifications.

406.04 METHOD OF MEASUREMENT. "Cold Recycled Base Course" will be measured by the number of square yards of material actually placed in accordance with the Plans and/or as directed by the Engineer.

406.05 BASIS OF PAYMENT. The accepted quantity of "Cold Recycled Base Course" will be paid for at the contract unit price per square yard as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, equipment, and materials, including

scarifying, mixing, pulverizing, spreading, reshaping, regrading, rolling, compacting, fine grading, any loading, hauling or other handling of recyclable materials, all costs incurred resulting from the Contractor's choice to process materials off-site, costs resulting from moving processed materials to allow for modifications to the remaining gravel base and/or subgrade, the removal and disposal of unsuitable materials, the movement of surplus asphalt stabilized base material from one location to another within the project limits, all material, placement and subsequent removal of temporary covers and structures, and all other incidentals required to finish the work, complete and accepted by the Engineer.

406.05.1 Other Operations and Materials. The following work operations and materials may be necessary to properly complete the work as specified above. When required, they will be measured and compensated for under appropriate bid items as follows:

a. Cut and Match Asphalt Pavement.

b. Excavation (to modify the gravel base and/or subgrade or remove unsuitable materials).

c. Reconstruct Catch Basin "D" to Catch Basin "F."

d. Adjust Water Gates.

e. Adjust Gas Gates.

f. Gravel Borrow Subbase (to adjust the gravel base and/or subgrade or to replace unsuitable materials).

g. Coarse or Fine Aggregate from outside sources.

h. Water for Compaction Control.

i. Calcium Chloride for Pavement Rehabilitation.

j. Adjust Catch Basins or Manholes to Grade.

k. Trimming and Fine Grading (to adjust the gravel base or subgrade).

SECTION 407

HOT RECYCLE OPTION FOR BITUMINOUS PAVEMENTS

407.01 DESCRIPTION. This Specification provides the Contractor with the option of recycling reclaimed asphalt pavement (RAP) into the composition of the following mixes or applications.

a. Bituminous Concrete; Base Course
b. Bituminous Concrete; Binder Course

If the Contractor chooses this recycling option the following modifications to **SECTION 401; BITUMINOUS CONCRETE PAVEMENTS**, shall apply.

407.02 MATERIALS. Reclaimed Asphalt Pavement (RAP) shall consist of asphalt pavement recovered by cold milling or other removal techniques approved by the Engineer. New aggregate and asphalt cement shall be added to meet the required composition.

407.02.1 Composition of Mixtures. No more than 30 percent RAP will be allowed in the bituminous mixture.

The recycled mixture of RAP, new aggregate and added asphalt cement shall meet the requirements specified in **Subsection M.03.01; Bituminous Concrete Pavements**, for aggregate gradation and asphalt cement content. AASHTO TP2 shall be used for extracting and recovering the binder from the RAP. The added asphalt cement grade shall be selected so that the requirements for PG 64-28 specified in **Subsection M.03.02.1; Performance Graded Asphalt Cement,** shall be met.

a. Job Mix Formula. For any bituminous mixture containing RAP, the Contractor shall formulate and submit to the Engineer a Job Mix Formula (JMF) which shall include:

1. Gradation and asphalt content of the RAP.

2. Gradation of recycled mixture.

3. Percentage of RAP added.

4. New aggregate source(s).

5. Total asphalt cement content (based on total mixture weight).

6. Added asphalt cement content (based on total mixture weight).

7. Grade of added asphalt cement.

8. Recycling Agent Additive (Type and Amount; optional if needed)

407.02.2 Bituminous Material. The added asphalt cement may be PG 64-28, PG 58-28, PG 58-34, PG 52-34 or other asphalt cement grades approved by the Engineer.

407.02.3 Reclaimed Asphalt Pavement (RAP). The aggregate component of the RAP shall meet the requirement of **Subsection M.03.02.2** of these Specifications. The bitumen component of the RAP shall be asphalt cement and shall be free of significant contents of solvents, tars or other contaminating substances that will make the RAP unacceptable for recycling as determined by the Engineer. The RAP shall be separated according to specific pavement sources by the Contractor unless otherwise permitted by the Engineer.

a. Approval of RAP Quality. The Engineer will use one of the following criteria to approve the RAP quality:

1. RAP obtained from a pavement which was constructed with asphalt cement and aggregates that meet the current requirements of **Subsection M.03.02.2** of these Specifications.

2. If the source of the RAP or its quality is not known, the Contractor shall submit to the Department at least 15 calendar days prior to the start of paving the following:

(a) Designated use of the RAP and approximate proportions.

(b) A five pound (minimum) sample representing the RAP to be incorporated into the recycled mixture.

(c) The absolute viscosity (140°F) of the bituminous material recovered from the RAP.

The Engineer will determine the acceptability of the RAP for the designated use. Details for sampling and testing the RAP are available from the Engineer.

b. Acceptance Requirements. The RAP will be accepted on the basis of the following:

1. Certification from the Contractor stating the source of the RAP, if known.

2. Analysis of RAP and its components conducted by the Contractor and approved by the Engineer. This will be submitted as required to insure the consistency of the RAP.

c. Stockpile Requirements. RAP from similar pavement types and sources shall be stockpiled on a free draining base separated from other aggregates and RAP sources and shall be free of foreign materials. The stockpile must contain at a minimum the amount projected to be used in five days or necessary to complete the project.

Prior to entry into the mixer, the RAP shall have a consistent gradation from coarse to fine with 100 percent passing the maximum size sieve allowed by the job mix formula.

407.02.4 Recycling Agent Additives. The recycling agent additive shall be approved by the Engineer and shall be chemically and physically compatible with asphalt cement. Recycling agent additive material shall be composed of selected maltene and asphaltene fractions derived from petroleum crude. The additive when mixed with aged asphalt shall restore the properties of the aged asphalt to a level that is reasonably consistent with the requirements of current specifications for the new asphalt.

407.03 CONSTRUCTION METHODS.

407.03.1 Batch Plant. The plant shall meet all the applicable requirements of **Subsection 401.03.1; Bituminous Mixing Plant**, with exceptions and additions as noted below. It shall be modified as required to permit recycling in conformance with all local, state and federal air pollution standards. The recycling modification shall be such that it provides a separate, independent, controlled cold feed system to introduce the salvaged bituminous pavement material into the weigh box for automatic proportioning, with new (virgin) aggregates, liquid asphalt and additives as required. This cold feed system shall also be equipped with a scalping screen to insure that all bituminous pavement material being recycled will be 100 percent passing the maximum size sieve allowed by the job mix formula. The recording equipment shall be capable of automatically recording the batch weight of the salvaged bituminous pavement material along with other batch components, on the required delivery tickets.

The new (virgin) aggregates shall be dried and heated to a sufficiently high temperature to produce a recycled mixture with a discharge temperature of at least 280°F or as approved by the Engineer. The salvaged bituminous pavement material to be recycled shall be added to the heated aggregates in the weigh box at a rate that will minimize heat loss and provide for efficient plant operations. The salvaged bituminous pavement material to be recycled shall not be preheated prior to being added to the weigh bin. The combined aggregate and pavement material shall be mixed in the pugmill for approximately 20 seconds, after which the mixture shall be sprayed with the asphalt cement and additives, as required, and mixed for approximately 25 seconds more. The mixing time may be increased if, in the opinion of the Engineer, the aggregate is not sufficiently coated with asphalt. These components shall be proportioned and mixed so as to fall within the limits of the approved job mix formula.

407.03.2 Drum Dryer Mixing Plant. The plant shall meet all the applicable requirements of **Subsection 401.03.1; Bituminous Mixing Plant,** with exceptions and additions noted below. The plant shall consist of a dryer with a dual entry system capable of drying, heating and mixing new aggregate and salvaged bituminous pavement material to the temperature and gradation requirements established in the job mix formula. At no time shall the RAP material be in contact with the flame of the burner. It shall be capable of recycling in conformance with all local, State and Federal air pollution standards. This type plant shall also conform to the following Specifications:

a. Cold Feed System. The plant shall have an adjustable feed rate control for the salvaged bituminous pavement feeder, as well as for the cold aggregate feeder and the mineral filler feeder.

b. Mixer Unit.

1. The Drum Mix Plant shall utilize a center entry system for recycling purposes.

2. The moisture content of the mixture upon discharge from the mixer shall not exceed 1.5 percent by weight and the mixture shall have a minimum temperature of 280°F.

c. Automated Blending System.

1. The plant shall have an automated blending system for proportioning virgin aggregate, liquid bitumen, additives as needed, and recycled material.

2. The blending system shall include a hardcopy strip printer; capable of totaling and printing at intervals quantities of virgin aggregate, liquid bitumen, additives as needed, and recycled material.

407.04 METHOD OF MEASUREMENT. "Base Course" and "Binder Course" which have been produced utilizing the Hot Recycle Option will be measured according to **Subsection 401.04** of these Specifications.

407.05 BASIS OF PAYMENT. The accepted quantities of "Base Course" and "Binder Course" which have been produced utilizing the Hot Recycle Option will be paid for according to **Subsection 401.05** of these Specifications.

SECTION 408

CLEANING, ROUTING, AND SEALING CRACKS IN BITUMINOUS CONCRETE PAVEMENT

408.01 DESCRIPTION. This work consists of performing all operations in connection with the reshaping, cleaning and filling of construction and random cracks in bituminous concrete pavements at the locations indicated in the Plans or as directed by the Engineer, all in accordance with these Specifications.

408.02 MATERIALS.

408.02.1. Cracks Less than One Inch in Width. Poured joint seal material shall be an asphalt rubber compound, hot poured type, conforming to the requirements of AASHTO M173 and approved by the Engineer.

408.02.2 Cracks One Inch and Over in Width. Bituminous Concrete, Class I-2.

408.03 CONSTRUCTION METHODS.

408.03.1 Equipment. Equipment shall be subject to the approval of the Engineer and maintained in a satisfactory working condition at all times.

a. The Router for reshaping cracks shall be vertical spindle or rotary type cutter.

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

c. Self-propelled Vacuum Sweeper. Small self-propelled vacuum sweeper designed especially for use in cleaning highway and airfield pavements shall be used to remove debris, dirt, and dust from routed cracks.

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

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

f. Hand Pouring Pots must be equipped with mobile carriage and rubber shoe and have a flow control valve which allows all cracks to be filled to refusal so as to eliminate all voids or entrapped air, and not leave unnecessary surplus crack sealer on pavement surfaces.

g. Equipment for blowing clean, drying, and rejuvenating sidewalls of cracks and joints shall be a unit which operates at 3,000 feet per second velocity.

408.03.2 Preparation of Cracks.

a. General. No crack sealing material shall be applied in wet cracks or where frost, snow, or ice is present nor when the ambient temperature is below 40°F.

b. Reshaping. All cracks 1/8-inch and wider shall be routed to a minimum width of ½-inch and minimum depth of ½-inch and thoroughly cleaned by compressed air to remove all dirt, foreign material, and loose edges from same.

c. Cracks over ½-inch in width do not require reshaping, but must be thoroughly cleaned by compressed air as above.

d. Debris Removal. All old material and other debris removed from the cracks shall be removed from pavement surface immediately by means of vacuum sweepers or hand brooms.

408.03.3 Cracks Less than One Inch in Width.

a. Preparation of Sealer. Joint sealing material shall be heated and applied at temperature specified by the manufacturer and approved by the Engineer.

b. Installation of Sealer. All cracks shall be sealed as specified herein, and the sealer shall be well bonded to the pavement. Unless otherwise directed, the cracks shall be completely filled flush with the pavement, and not less than 1/8-inch below surface, without formation of voids or entrapped air. More than one application of crack sealer may be necessary to fill cracks to required level.

408.03.4 Cracks One Inch and Over in Width. All cracks of sufficient depth and one inch or over in width shall first be brush coated with bituminous material on all contact surfaces, filled with Class I-2 bituminous mixture and compacted, all in accordance with the applicable provisions of **Subsection 401.03.10; Compaction**, of these Specifications.

408.04 METHOD OF MEASUREMENT.

408.04.1 Cracks Less Than One Inch in Width. "Cleaning, Routing, and Sealing Cracks in Bituminous Pavement: Cracks Less Than One Inch in Width" will be measured by the number of linear feet of sealed joints actually installed in accordance with the Plans and/or as directed by the Engineer.

408.04.2 Cracks One Inch and Over in Width. "Cleaning, Routing, and Sealing Cracks in Bituminous Pavement: Cracks One Inch and Over in Width" will be measured by the number of linear feet of sealed joints actually installed in accordance with the Plans and/or as directed by the Engineer.

408.05 BASIS OF PAYMENT.

408.05.1 Cracks Less Than One Inch in Width. The accepted quantity of "Cleaning, Routing and Sealing Cracks in Bituminous Pavement: Cracks Less Than One Inch in Width" will be paid for at the contract unit price per linear foot as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, and equipment, and for all other incidentals required to finish the work, complete and accepted by the Engineer.

408.05.2 Cracks One Inch and Over in Width. The accepted quantity of "Cleaning, Routing and Sealing Cracks in Bituminous Pavement: Cracks One Inch and Over in Width" will be paid for at the contract unit price per linear foot as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, and equipment, and for all other incidentals required to finish the work, complete and accepted by the Engineer.

SECTION 409

SAWING AND SEALING TRANSVERSE JOINTS IN BITUMINOUS CONCRETE PAVEMENTS OVER RIGID BASE

409.01 DESCRIPTION. This work consists of making a saw cut transversely across the finished bituminous surface pavement and filling it with a hot poured asphalt rubber compound at the locations indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

409.02 MATERIALS. Poured joint seal material shall be an asphalt rubber compound of the hot poured type conforming to AASHTO M173 and approved by the Engineer.

409.03 CONSTRUCTION METHODS.

409.03.1 Equipment. The equipment to be used shall conform to the applicable requirements of **Subsection 408.03.1**, with the following exceptions:

a. Router. A router will not be required.

b. Power Saw and Blades. Saw and blades of such size and configuration that saw cuts can be made with one pass, and shall not cause damage or ravelling to the adjacent pavement sidewalls.

409.03.2 Operation.

a. General. The cut shall be made directly over the existing underpavement's transverse joints. The existing joints shall be located and marked so as to insure that the saw cuts are made directly over them.

b. Sawing Joints. The joints shall be constructed no sooner than 30 days after the surface course has been applied.

The saw cutting of the joints shall be made with an approved power driven saw. The cuts shall be 3/8-inch wide by 3/4-inch deep. The saw cuts shall be made with an abrasive blade and sawn dry.

The completed cuts shall extend in a straight line transversely across the pavement to the extent of the existing underpavement's transverse joints. Each joint to be sawed will be referenced by the Contractor. It shall be the responsibility of the Contractor to insure that the saw cuts are constructed directly over the existing underpavement's transverse joints.

c. Cleaning and Sealing Joints. A sawed joint shall be air cleaned and sealed immediately after the saw cut has been made. Traffic shall not be allowed to knead together or damage the sawed joint. Each joint shall be thoroughly cleaned and dried prior to placement of the sealing compound. Any cleaning required shall be performed by blowing out all dirt, dust or deleterious matter that may have accumulated in the newly sawed joint. Sufficient air pressure shall be provided to insure thorough cleaning.

The melter shall be either oil or gas-fired, and shall be of the double walled, oil bath type with a power driven mechanical agitator and circulation pump. The melter shall be equipped with a thermostat to maintain the sealing compound within the range of temperatures specified by the manufacturer and with a suitably mounted thermometer to indicate the temperature of the sealing compound in the melter. The melting temperature of the sealer will be furnished by the manufacturer, and shall not be exceeded by more than 10°F.

The joint seal shall be applied with a pressurized mobile carriage and rubber shoe and the system shall have a flow control valve which allows all cracks to be filled to refusal so as to eliminate all voids or entrapped air and so as to not leave unnecessary surplus crack sealer on the pavement surface. The hot seal shall completely fill the joint, such that, after cooling, the level of the sealer will be flush with the pavement surface. Any depression in the seal shall be brought up to the specified limit by the further addition of hot seal. Care shall be taken in the sealing of the joints such that the final appearance will present a neat fine line. Overfilling of the joints will not be allowed, and spillage of the sealer should be avoided. All workmanship shall be of the highest quality, and all excess or spilled sealer must be removed from the pavement by approved methods and discarded.

409.04 METHOD OF MEASUREMENT. "Sawing and Sealing Transverse Joints in Bituminous Concrete Pavement" will be measured by the number of linear feet of sealed joint actually installed in accordance with the Plans and/or as directed by the Engineer.

409.05 BASIS OF PAYMENT. The accepted quantity of "Sawing and Sealing Transverse Joints in Bituminous Concrete Pavement" will be paid for at the contract unit price per linear foot as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials and equipment, and for all other incidentals required to finish the work, complete and accepted by the Engineer.

SECTION 410

TEMPORARY PATCHING MATERIAL 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, all in accordance with these Specifications.

410.02 MATERIALS. The temporary patching material shall conform to the requirements for Class I-1 Surface Course as set forth in **Subsection M.03.01** or to 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 the pothole, commencing ten calendar days following the official notice to proceed. Potholes shall be repaired within 24 hours of notification by the Engineer.

Repair shall consist of placing asphalt patching material by hand in up to two, 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 for Pothole Repairs" as specified in this Section will not be measured by a single unit of measurement usually associated with a specific Proposal item. Rather, this work will be documented and paid for on a Force Account basis as set forth below in **Subsection 410.05.1**.

410.04.1 Trenches. "Temporary Patching Material/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 for 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. The accepted quantity of "Temporary Patching Material/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 for all other incidentals required to finish the work, complete and accepted by the Engineer.

PART 500

CONCRETE PAVEMENTS

SECTION 501

PORTLAND CEMENT CONCRETE PAVEMENT AND BASE

501.01 DESCRIPTION. This work consists of constructing Portland cement concrete base or pavement, with or without reinforcement, on a prepared subgrade or subbase in reasonably close conformity with the dimensions and details indicated on the Plans, all in accordance with these Specifications.

501.02 MATERIALS. Materials shall meet the requirements of **SECTION M.02; PORTLAND CEMENT CONCRETE** and **SECTION M.05; METALS**, of these Specifications.

501.03 CONSTRUCTION METHODS.

501.03.1 Construction Requirements. The classifications, proportioning, testing, batching, mixing, handling, placing, finishing and curing of Portland cement concrete pavement or base shall conform to the applicable requirements of **SECTION 601; PORTLAND CEMENT CONCRETE,** of these Specifications.

501.03.2 Equipment.

a. Finishing Machines. Equipment for finishing concrete pavement shall be mechanical, self-propelled, spreading and finishing machines capable of consolidating the concrete and producing a finished surface as specified herein. Finishing machines shall be equipped with at least two oscillating type transverse screeds which shall be adjustable to produce a crowned or flat surface as required.

b. Vibrators. Vibrators, for full width vibration of concrete paving, may be either the surface pan type or the internal types with either immersed tube or multiple spuds. They may be attached to the spreader or the finishing machine, or may be mounted on a separate carriage to accommodate either slip form or side form paving methods. They shall not come in contact with the joint, load transfer devices, subgrade, reinforcing, or side forms. The frequency of the surface vibrators shall not be less than 3,500 impulses per minute and the frequency of the internal type shall not be less than 5,000 impulses per minute for tube vibrators and not less than 7,000 impulses per minute for spud vibrators.

Vibrators shall be rubber tipped to prevent damage to epoxy-coated reinforcing steel.

c. Concrete Saw. When sawing joints is elected or specified, the Contractor shall provide sawing equipment adequate in number of units and power to complete the sawing with a water-cooled diamond edge saw blade or an abrasive wheel to the required dimensions and at the required rate. The Contractor shall provide at least one standby saw in good working order.

An ample supply of saw blades shall be maintained at the site of the work at all times during sawing operations. The Contractor shall provide adequate artificial lighting facilities for night sawing.

d. Forms. Straight side forms shall be made of a metal having a thickness of not less than 7/32-inch and shall be furnished in sections not less than 10 feet in length. Forms shall have a depth equal to or greater than the prescribed edge thickness of the concrete, without horizontal joint, and a base width equal to or greater than the depth of the forms. Flexible or curved forms of proper radius shall be used for curves of 100-foot radius or less. Flexible or curved forms shall be of a design acceptable to the Engineer. Forms shall be provided with adequate devices for secure setting so that when in place they will withstand, without visible spring or settlement, the impact and vibration of the consolidating and finishing equipment. Flange braces shall extend outward on the base not less than two-thirds the height of the form. Forms with battered top surfaces, and bent, twisted, or broken forms shall be removed from the work. Repaired forms shall not be used until inspected and approved by the Engineer. Built-up forms shall not be used except where the total area of pavement of any specified thickness on the project is less than 2,000 square yards. The top face of the form shall not vary from a true plane more than 1/8-inch in 10 feet, and the upstanding leg shall not vary more than 1/4-inch. The forms shall contain provisions for locking the ends of abutting form sections together tightly, and for secure setting.

501.03.3 Preparation of Grade. After the roadbed has been graded and compacted to meet the density requirements of **Subsection 301.03.2** of these Specifications, the grade shall be trimmed approximately to correct elevation, extending the work at least 2 feet beyond each edge of the proposed concrete pavement or base.

501.03.4 Setting Support.

a. Base Support. The foundation under the forms shall be hard and true to grade so that the form, when set, will be firmly in contact for its whole length and at the specified grade.

b. Form Setting. Forms shall be set sufficiently in advance of the point where concrete is being placed. Forms shall be staked into place with not less than 3 pins for each 10-foot section. A pin shall be placed at each side of every joint. Form sections shall be tightly interlocked, free from play or movement in any direction. The forms shall not deviate from true line by more than 1/4-inch at any point. No excessive settlement or springing of forms under the finishing machine will be tolerated. Forms shall be cleaned and oiled prior to the placing of concrete.

c. Grade and Alignment. The alignment and grade elevations of the forms shall be checked and corrections made by the Contractor before placing the concrete. When any form has been disturbed or any grade has become unstable, the form shall be reset and rechecked.

501.03.5 Conditioning of Subgrade or Base Course. When side forms have been securely set to grade, the subgrade or base course shall be brought to proper cross section. High areas shall be trimmed to proper elevation. Low areas may be filled and compacted to a condition similar to that of surrounding grade, or filled with concrete integral with the pavement. The finished grade shall be maintained in a smooth and compacted condition until the pavement is placed.

Unless waterproof subgrade or base course cover material is specified, the subgrade or base course shall be uniformly moist when the concrete is placed. If it subsequently becomes too dry, the subgrade or base course shall be sprinkled, but the method of sprinkling shall not be such as to form mud or pools of water.

501.03.6 Placing Concrete. Concrete shall not be placed on soft, muddy, or frozen subgrade or subbase. Also, concrete shall not be placed when subgrade is frozen under adjacent pavement which is to remain in place.

The concrete shall be deposited on the grade in such manner as to require as little rehandling as possible. Unless truck mixers, truck agitators, or nonagitating hauling equipment are equipped with means for discharge of concrete without segregation of the materials, the concrete shall be unloaded into an approved spreading device and mechanically spread on the grade in such manner to prevent segregation of the materials. Placing shall be continuous between transverse joints without the use of intermediate bulkheads. Necessary hand spreading shall be done with shovels, not rakes. Workmen shall not be allowed to walk in the freshly mixed concrete with boots or shoes coated with earth or foreign substances.

Where concrete is to be placed adjoining a previously constructed lane of pavement and mechanical equipment will be operated upon the existing lane of pavement, that pavement shall meet the minimum flexural strength of 525 pounds per square inch when tested by the third-point method in accordance with AASHTO T97. If only finishing equipment is carried on the existing lane, paving in adjoining lanes may be permitted after three days.

Concrete shall be thoroughly consolidated against and along the faces of all forms and along the full length and on both sides of all joint assemblies, by means of internal vibrators inserted in the concrete. Vibrators shall not be permitted to come in contact with a joint assembly, the grade, reinforcement, or a side form. In no case shall the vibrator be operated longer than 10 seconds in any one location. The vibration shall be of sufficient duration to thoroughly consolidate the concrete but not so long as to produce segregation.

Concrete shall be deposited as near to expansion and contraction joints as possible without disturbing them, but shall not be dumped from the discharge bucket or hopper onto a joint assembly unless the hopper is well centered on the joint assembly.

Should any concrete materials fall on or be worked into the surface of a completed slab, they shall be removed immediately by approved methods.

501.03.7 Test Specimens. The Contractor shall furnish the concrete necessary for casting test beams and cylinders. The beams shall be cured by a designated method as specified for the pavement according to AASHTO T23.

501.03.8 Strike-off of Concrete and Placement of Reinforcement. Following the placing of the concrete, it shall be struck off to conform to the cross section shown on the Plans and to an elevation such that when the concrete is properly consolidated and finished, the surface of the pavement will be at the elevation shown on the Plans. When reinforced concrete pavement is placed in two layers, the entire width of the bottom layer shall be struck off to such length and depth that the sheet of fabric or bar mat may be laid full length on the concrete in its final position without further manipulation. The reinforcement shall then be placed directly upon the concrete, after which the top layer of the concrete shall be placed, struck off and screeded. Any portion of the bottom layer of concrete which has been placed more than 30 minutes without being covered

with the top layer shall be removed and replaced with freshly mixed concrete at the Contractor's expense. When reinforced concrete is placed in one layer, the reinforcement may be positioned in advance of concrete placement or it may be placed in plastic concrete, after spreading by mechanical or vibratory means. The surface of reinforcing steel shall be free from any material which could impair bond of the steel with the concrete, all in accordance with the applicable requirements of **SECTION 808; CAST-IN-PLACE STRUCTURE CONCRETE MASONRY**, of these Specifications.

501.03.9 Joints. Joints shall be constructed of the type and dimensions, and at the locations required by the Plans or Special Provisions.

a. Longitudinal Joint. Longitudinal sawed joints shall be cut by means of approved concrete saws to the depth, width and line shown on the Plans. Suitable guide lines or devices shall be used to assure cutting the longitudinal joint on the true line as shown on the Plans. The longitudinal joint shall be sawed before the end of the curing period and before any equipment or vehicles are allowed on the pavement. The sawed area shall be thoroughly cleaned and, if required, the joint shall immediately be filled with sealer.

b. Transverse Expansion Joints. The expansion joint filler shall be continuous from form to form, shaped to the subgrade and to the keyway along the form. Preformed joint filler shall be furnished in lengths equal to the pavement width or equal to the width of one lane. Damaged or repaired joint filler shall not be used unless approved by the Engineer.

The expansion joint filler shall be held in a vertical position. An approved installing bar, or other device, shall be used if required to secure preformed expansion joint filler at the proper grade and alignment during placing and finishing of the concrete. Finished joints shall not deviate more than 1/4-inch in the horizontal alignment from a straight line. If joint fillers are assembled in sections, there shall be no offsets between adjacent units. No plugs of concrete shall be permitted anywhere within the expansion space.

c. Transverse Contraction Joints. Transverse contraction joints shall consist of planes of weakness created by cutting grooves in the surface of the pavement and, when shown on the Plans, shall include load transfer assemblies.

1. Sawed Contraction Joints shall be created by sawing grooves in the surfaces of the pavement or base to the dimensions and at the spacing and lines shown on the Plans with an approved concrete saw. After each joint is sawed, the saw cut and adjacent concrete surface shall be thoroughly cleaned.

If curing blankets are used they shall be removed from the pavement only at the location(s) where a joint is to be sawed and only a sufficient width to allow the cut to be made. As soon as the cut has been made curing material shall be replaced. In no case shall either the top or edges of concrete be left unprotected for more than one-half hour.

Sawing of the joints shall commence as soon as the concrete has hardened sufficiently to permit sawing without excessive raveling, usually 4 to 24 hours. All joints shall be sawed before uncontrolled shrinkage cracking takes place. If necessary, the sawing operations shall be carried on during the day and night, regardless of weather conditions. The sawing of any joint shall be omitted if a crack occurs at or near the joint location prior to the time of sawing. Sawing shall be discontinued when a crack develops ahead of the saw. The pavement within the lane where cracks occur shall be removed to the full width of the lane and replaced. The minimum

lane length of pavement replacement shall be 6 feet. If cracking occurs on both sides of the same joint, the dowel assembly and a minimum of 3 feet on each side of the joint shall be removed and replaced, all at the Contractor's expense.

In general, all joints should be sawed in sequence. All contraction joints in lanes adjacent to previously constructed lanes shall be sawed before uncontrolled cracking occurs. If extreme conditions exist which make it impractical to prevent erratic cracking by early sawing, the contraction joint groove shall be formed prior to initial set of concrete.

2. Transverse Construction Joints shall be constructed when there is an interruption of more than 30 minutes in the concreting operations. No transverse joint shall be constructed within 10 feet of an expansion joint, contraction joint, or plane of weakness. If sufficient concrete has not been mixed at the time of interruption to form a slab at least 10 feet long, the excess concrete back to the last preceding joint shall be removed and disposed of.

3. Load Transfer Devices. Dowels, when used, shall be held in position parallel to the surface and centerline of the slab by a metal device that is left in the pavement.

The dowels shall be thoroughly coated with an approved lubricant to prevent the concrete from binding to that portion of the dowel. An approved metal dowel cap or sleeve shall be furnished for each dowel bar used with the expansion joints. The caps or sleeves shall fit the dowel bar tightly and the closed end shall be watertight.

In lieu of using dowel assemblies at contraction joints, dowel bars may be placed in the full thickness of pavement by a mechanical device approved by the Engineer.

501.03.10 Final Strike-off, Consolidation and Finishing of Concrete Pavement.

a. Sequence. The sequence of operations shall be the strike-off and consolidation; machine finishing; floating; straightedging; and texturing.

Following the placement of concrete, it shall be struck off to conform to the cross section indicated on the Plans and to an elevation such that once the concrete is properly consolidated and finished, the surface of the pavement will be at the elevation indicated on the Plans.

In general, the addition of surficial water to the surface of the concrete to assist in finishing operations will not be permitted. If the application of water to the surface is permitted, it shall be applied as a fog spray by means of approved spray equipment.

b. Finishing at Joints. The concrete adjacent to joints shall be compacted or firmly placed without voids or segregation against the joint material, also under and around all load transfer devices, joint assembly units, and other features designed to extend into the pavement. Concrete adjacent to joints shall be mechanically vibrated as required in **Subsection 501.03.6**.

After the concrete has been placed and vibrated adjacent to the joints as required in **Subsection 501.03.6**, the finishing machine shall be brought forward, operating in a manner to avoid damage or misalignment of joints. If uninterrupted operation of the finishing machine, to, over, and beyond the joints causes segregation of concrete, damage to, or misalignment of the joints, the finishing machine shall be stopped when the front screed is approximately 8 inches from the joint. Segregated concrete shall be removed from in front of and off the joint; the front

screed shall be lifted and set directly on top of the joint and the forward motion of the finishing machine resumed. When the second screed is close enough to permit the excess mortar in front of it to flow over the joint, it shall be lifted and carried over the joint. Thereafter, the finishing machine may be run over the joint without lifting the screeds, provided there is no segregated concrete immediately between the joint and the screed or on top of the joint.

c. Machine Finishing.

1. Nonvibratory Method. The concrete shall be distributed or spread as soon as placed. As soon as the concrete has been placed, it shall be struck off and screeded by an approved finishing machine. The machine shall go over each area of pavement as many times and at such intervals as necessary to give the proper compaction and to leave a surface of uniform texture. Excessive operation over a given area shall be avoided. The tops of the forms shall be kept clean by an effective device attached to the machine and the travel of the machine on the forms shall be maintained true without lift, wobbling, or other variation tending to affect the precision finish.

During the first pass of the finishing machine, a uniform ridge of concrete shall be maintained ahead of the front screed for its entire length.

2. Vibratory Method. When vibration is specified, vibrators for full width vibration of concrete paving slabs shall meet the requirements in **Subsection 501.03.2, Para. b**. If uniform and satisfactory density of the concrete is not obtained by the vibratory method at joints, along forms, at structures, and throughout the pavement, the Contractor will be required to furnish equipment and methods which will produce pavement conforming to the Specifications. All the provisions in **Para. c.1,** above, not in conflict with the provisions for the vibratory method shall govern.

d. Hand Finishing. Unless otherwise specified, hand finishing methods will not be permitted except under the following conditions:

In the event of breakdown of the mechanical equipment, hand methods may be used to finish the concrete already deposited on the grade when the breakdown occurs.

Narrow widths or areas of irregular dimensions where operations of the mechanical equipment is impractical may be finished by hand methods.

Concrete, as soon as placed, shall be struck off and screeded. An approved portable screed shall be used. A second screed shall be provided for striking off the bottom layer of concrete, if reinforcement is used.

The screed for the surface shall be at least 2 feet longer than the maximum width of the slab to be struck off. It shall be of approved design, sufficiently rigid to retain its shape, and be constructed either of metal or of other suitable material shod with metal.

Consolidation shall be attained by the use of a suitable vibrator or other approved equipment. If necessary, this shall be repeated until the surface is of uniform texture, true to grade and cross section, and free from porous areas.

e. Floating. After the concrete has been struck off and consolidated, it shall be further smoothed, trued, and consolidated by means of a longitudinal float, using one of the following methods as specified or permitted:

1. Hand Method. The hand-operated longitudinal float shall be not less than 12 feet in length and 6 inches in width, properly stiffened to prevent flexibility and warping. The longitudinal float, operated from foot bridges resting on the side forms and spanning but not touching the concrete, shall be worked with a sawing motion, while held in a floating position parallel to the road centerline, and passing gradually from one side of the pavement to the other. Movement ahead along the centerline of the pavement shall be in successive advances of not more than one-half the length of the float. Any excess water or soupy material shall be wasted over the side forms on each pass.

2. Mechanical Method. The mechanical longitudinal float shall be of a design approved by the Engineer, and shall be in good working condition. The tracks from which the float operates shall be accurately adjusted to the required crown. The float shall be accurately adjusted and coordinated with the adjustments of the transverse finishing machine so that a small amount of mortar is carried ahead of the float at all times. The forward speed shall be adjusted so that the float will lap the distance specified by the Engineer on each transverse trip. The float shall pass over each area of pavement at least two times, but excessive operation over a given area will not be permitted. Any excess water or soupy material shall be wasted over the side forms on each pass.

3. Alternative Mechanical Method. As an alternative to the Mechanical Method described above, the Contractor may use a machine composed of a cutting and smoothing float, or floats, suspended from and guided by a rigid frame. The frame shall be carried by four or more visible wheels riding on, and constantly in contact with, the side forms.

If necessary, following one of the preceding methods of floating, long-handled floats having blades not less than 5 feet in length and 6 inches in width may be used to smooth and fill in open textured areas in the pavement. Long-handled floats shall not be used to float the entire surface of the pavement in lieu of, or supplementing, one of the preceding methods of floating. When strike-off and consolidation are done by the hand methods and the crown of the pavement will not permit the use of the longitudinal float, the surface shall be floated transversely by means of the long-handled float. Care shall be taken not to work the crown out of the pavement during the operation. After floating, any excess water and laitance shall be removed from the surface of the pavement by a straightedge 10 feet or more in length. Successive drags shall be lapped one-half the length of the blade.

f. Straightedge Testing and Surface Correction. After the floating has been completed and the excess water removed, but while the concrete is still plastic, the surface of the concrete shall be tested for trueness with a 10-foot straightedge. For this purpose the Contractor shall furnish and use an accurate 10-foot straightedge swung from handles 3 feet longer than one-half the width of the slab. The straightedge shall be held in contact with the surface in successive positions parallel and perpendicular to the road centerline and the whole area gone over from one side of the slab to the other as necessary. Advance along the road shall be in successive stages of not more than one-half the length of the straightedge. Any depressions found shall be immediately filled with freshly mixed concrete, struck off, consolidated, and refinished. High areas shall be cut down and refinished. Special attention shall be given to assure that the surface across joints meets the requirements for smoothness. Straightedge testing and surface

corrections shall continue until the entire surface is found to be free from observable departures from the straightedge and the slab conforms to the required grade and cross section.

g. Final Finish. The final finish shall be specified or shown on the Plans and shall consist of one of the three finishes described as follows:

1. Broom Finish. If the surface texture is to be a broom finish, it shall be applied when the water sheen has practically disappeared. The broom shall be drawn from the center to the edge of the pavement with adjacent strokes slightly overlapping. The brooming operation shall be so executed that the corrugations produced in the surface shall be uniform in appearance and not more that 1/8-inch in depth. Brooming shall be completed before the concrete is in such condition that the surface will be torn or unduly roughened by the operation. The surface thus finished shall be free from rough and porous areas, irregularities, and depressions, resulting from improper handling of the broom. Brooms shall be of the quality, size, and construction and be so operated as to produce a surface finish meeting the approval of the Engineer. Subject to satisfactory results being obtained and approval of the Engineer, the Contractor will be permitted to substitute mechanical brooming in lieu of the manual brooming as herein described.

2. Belt Finish. If the surface texture is to be a belt finish, when straightedging is complete and water sheen has practically disappeared and just before the concrete becomes nonplastic, the surface shall be belted with a 2-ply canvas belt not less than 8-inches wide and at least 3 feet longer than the pavement width. Hand belts shall have suitable handles to permit controlled, uniform manipulation. The belt shall be operated with short strokes transverse to the road centerline and with a rapid advance parallel to the centerline.

3. Drag Finish. If the surface texture is to be a drag finish, a drag shall be used which shall consist of a seamless strip of damp burlap or cotton fabric, which shall produce a uniform surface of gritty texture after dragging it longitudinally along the full width of pavement. For pavement 16 feet or more in width, the drag shall be mounted on a bridge which travels on the forms. The dimensions of the drag shall be such that a strip of burlap or fabric at least 3 feet wide is in contact with the full width of pavement surface while the drag is used. The drag shall consist of not less than 2 layers of burlap with the bottom layer approximately 6 inches wider than the upper layer. The drag shall be maintained in such condition that the resultant surface is of uniform appearance and reasonably free from grooves over 1/8-inch in depth. Drags shall be maintained clean and free from encrusted mortar. Drags that cannot be cleaned shall be discarded and new drags substituted.

h. Edging at Forms and Joints. After the final finish, but before the concrete has taken its initial set, the edges of the pavement along each side of each slab, and on each side of transverse expansion joints, formed joints, transverse construction joints, and emergency construction joints, shall be worked with an approved tool and rounded to the radius required by the Plans. A well-defined and continuous radius shall be produced and a smooth, dense mortar finish obtained. The surface of the slab shall not be unduly disturbed by tilting of the tool during use.

At all joints, any tool marks appearing on the slab adjacent to the joints shall be eliminated by brooming the surface. In doing this, the rounding of the corner of the slab shall not be disturbed. All concrete on top of the joint filler shall be completely removed.

All joints shall be tested with a straightedge before the concrete has set, and corrections made if one side of the joint is higher than the other or if they are higher or lower than the adjacent slabs.

i. Concrete Base. In the case of concrete base, the above requirements for finishing and/or longitudinal floating are waived.

501.03.11 Surface Test.

a. Concrete Pavement. As soon as the concrete has hardened sufficiently, the pavement surface shall be tested with an approved 10-foot straightedge furnished by the Contractor. Areas showing high spots of more than 1/4-inch but not exceeding 1/2-inch in ten feet shall be marked and immediately ground down with an approved grinding tool to an elevation where the area or spot will not show surface deviations in excess of 1/4-inch when tested with a 10-foot straightedge. Where the departure from correct cross section exceeds ½-inch, the pavement shall be removed and replaced by and at the expense of the Contractor.

Any area or section so removed shall be not less than 10 feet in length nor less than the full width of the lane involved. When it is necessary to remove and replace a section of pavement, any remaining portion of the slab adjacent to the joints that is less than 10 feet in length, shall also be removed and replaced.

b. Concrete Base. The surface of the concrete base shall be roughened by any means acceptable to the Engineer such as brooming, tinning, or burlap drag. The surface shall be finished so that there will be no deviation of more than 3/8-inch between any two contact points when tested with a 10-foot straightedge.

501.03.12 Curing. Immediately after the finishing operations have been completed and as soon as marring of the concrete will not occur, the entire surface of the newly placed concrete shall be cured in accordance with the applicable provisions of **Subsection 601.03.8** of these Specifications.

501.03.13 Removing Forms. Unless otherwise provided, forms shall not be removed from freshly placed concrete until it has set for at least 12 hours, except auxiliary forms used temporarily in widened areas. Forms shall be removed carefully so as to avoid damage to the pavement. After the forms have been removed, the sides of the slab shall be cured as outlined in one of the methods indicated above. Major honeycombed areas will be considered as defective work and shall be removed and replaced. Any area or section so removed shall not be less than 10 feet in length nor less than full width of the lane involved. When it is necessary to remove and replace a section of pavement, any remaining portion of the slab adjacent to the joints that is less than 10 feet in length, shall also be removed and replaced.

501.03.14 Sealing Joints. If the joints are to be sealed, they shall be filled with joint sealing material before the pavement is opened to traffic, and as soon after completion of the curing period as is feasible. Just prior to sealing, each joint shall be thoroughly cleaned of all foreign material, including membrane curing compound and the joint faces shall be cleaned and surface dry when the seal is applied. Material for seal applied hot shall be stirred during heating so that localized overheating does not occur.

The sealing material shall be applied to each joint opening to conform to the details shown

on the Plans or as directed by the Engineer. The pouring shall be done in such a manner that the material will not be spilled on the exposed surfaces of the concrete. Any excess material on the surface of the concrete pavement shall be removed immediately and the pavement surface cleaned. The use of sand or similar material as a cover for the seal will not be permitted. Poured joint-sealing material shall not be placed when the air temperature in the shade is less than 50°F, unless approved by the Engineer.

When specified, preformed compression seals and lubricant adhesive shall conform to **Subsection M.02.10.3** of these Specifications.

501.03.15 Protection of Pavement. The Contractor shall protect the pavement and its appurtenances against both public traffic and traffic caused by his own employees and agents.

Any damage to the pavement, occurring prior to final acceptance, shall be repaired or the pavement replaced.

501.03.16 Opening to Traffic. The Engineer will decide when the pavement or base shall be opened to traffic. Pavement or base will not be opened to traffic until specimen beams have attained a flexural strength of 525 pounds per square inch when tested by the third-point method, in accordance with AASHTO T97.

501.03.17 Concrete Pavement-Slip Form Method. If the Contractor elects to use the slip-form method, the following provisions shall apply:

a. Grade. After the grade or base has been placed and compacted to the required density, the areas which will support the paving machine shall be cut to the proper elevation by means of a properly designed machine. The grade on which the pavement is to be constructed shall then be brought to the proper profile by means of a properly designed machine. If the density of the base is disturbed by the grading operations, it shall be corrected by additional compaction before concrete is placed. The grade should be constructed sufficiently in advance of the placing of the concrete. If any traffic is allowed to use the prepared grade, the grade shall be checked and corrected immediately ahead of the placing of the concrete.

b. Placing Concrete. The concrete shall be placed with an approved slip-form paver designed to spread, consolidate, screed, and float-finish the freshly placed concrete in such manner that a minimum of hand finish will be necessary to provide a dense and homogenous pavement in conformance with the Plans and Specifications. The machine shall vibrate the concrete for the full width and depth of the strip of pavement being placed. Such vibration shall be accomplished with vibrating tubes or arms working in the concrete. The sliding forms shall be rigidly held together laterally to prevent spreading of the forms. The forms shall trail behind the paver for such a distance that no appreciable slumping of the concrete will occur, and that necessary final finishing can be accomplished while the concrete is still within the forms.

The concrete shall be held at a uniform consistency, having a slump of not more than 2 inches. The slip-form paver shall be operated with as nearly a continuous forward movement as possible and all operations of mixing, delivering and spreading concrete shall be so coordinated as to provide uniform progress with stopping and starting of the paver held to a minimum. If, for any reason, it is necessary to stop the forward movement of the paver, the vibratory and tamping elements shall also be stopped immediately. No tractive force shall be applied to the machine, except that which is controlled from the machine.

c. Finishing. The surface smoothness and texture shall meet the requirements of **Subsection 501.03.10** and **Subsection 501.03.11**.

d. Curing. Unless otherwise specified, curing shall be done in accordance with one of the methods included in **Subsection 601.03.8**. The curing media shall be applied at the appropriate time and shall be applied uniformly and completely to all surfaces and edges of the pavement.

e. Joints. All joints shall be constructed in accordance with **Subsection 501.03.9** and sealed in accordance with **Subsection 501.03.14**.

f. Protection Against Rain. In order that the concrete may be properly protected against the effects of rain before the concrete is sufficiently hardened, the Contractor will be required to have available at all times materials for the protection of the edges and surface of the unhardened concrete. Such protective materials shall consist of standard metal forms or wood plank having a nominal thickness of not less than 2 inches and a nominal width of not less than the thickness of the pavement at its edge for the protection of the pavement edges, and covering material such as burlap or cotton mats, curing paper, or plastic sheeting material for the protection of the surface of the pavement. When rain appears imminent, all paving operations shall stop and all available personnel shall begin placing forms against the sides of the pavement and covering the surface of the unhardened concrete with the protective covering.

501.03.18 Tolerance in Pavement or Base Thickness. The thickness of the pavement or base will be determined by the average caliper measurement of cores tested in accordance with AASHTO T148.

For the purpose of establishing an adjusted unit price for the pavement or base, units to be considered separately are defined as 1,000 linear feet of pavement in each traffic lane starting at the end of the pavement bearing the smaller station number. The last unit in each lane shall be 1,000 feet plus the fractional part of 1,000 feet remaining. One core will be taken at random by the Department in each unit. When the measurement of the core from a unit is not deficient more than 3/8-inch from the Plan thickness, full payment will be made. When such measurement is deficient more than 3/8-inch and not more than 1 inch from the Plan thickness two additional cores at intervals of not less than 300 feet will be taken and used in the average thickness for that unit. An adjusted unit price as provided in **Subsection 501.05.2** will be paid for the unit represented.

Other areas such as intersections, entrances, crossovers, ramps, etc., will be considered as one unit and the thickness of each unit will be determined separately. Small irregular unit areas may be included as part of another unit. At such points as the Engineer may select in each unit, one core will be taken for each 1,000 square yards of base or pavement, or fraction thereof, in the unit. If the core so taken is not deficient more than 3/8-inch from the Plan thickness, full payment will be made. If the core is deficient in thickness by more than 3/8-inch but not more than 1 inch from the Plan thickness, two additional cores will be taken from the area represented and the average of the three cores determined. If the average measurement of these three cores is not deficient more than 3/8-inch from the Plan thickness, full payment will be made. If the average thickness of the three cores is deficient more than 3/8-inch but not more than 1 inch from the Plan thickness, an adjusted unit price as provided in **Subsection 501.05.2** will be paid for the area represented by these cores.

In calculating the average thickness of the base, measurements which are in excess of the specified thickness by more than 3/8-inch will be considered as the specified thickness plus 3/8-inch, and measurements which are less than the specified thickness by more than 1 inch will not be included in the average.

When the measurement of any core is less than the Plan thickness by more than 1 inch, the actual thickness of the base in this area will be determined by taking additional cores at 10-foot intervals parallel to the centerline in each direction from the affected location until in each direction a core is found which is not deficient by more than 1 inch. Areas found deficient in thickness by more than 1 inch shall be evaluated by the Engineer. If the Engineer decides that the deficient areas should be removed, they shall be removed and replaced with concrete of the thickness shown on the Plans. Exploratory cores for deficient thickness will not be used in averages for adjusted unit price.

The method of establishing the adjusted unit price for pavement based on the measurement of cores is specified below in **Subsection 501.05.2**.

501.04 METHOD OF MEASUREMENT. "Portland Cement Concrete Pavement" and "Portland Cement Concrete Base" will be measured by the number of square yards of each actually provided in accordance with the Plans and/or as directed by the Engineer.

The width for measurement will be the width of the pavement shown on the typical cross section of the Plans, additional widening where called for, or as otherwise directed in writing by the Engineer. The length will be measured horizontally along the centerline of each roadway or ramp.

501.05 BASIS OF PAYMENT.

501.05.1 General. The accepted quantities of "Portland Cement Concrete Pavement" and "Portland Cement Concrete Base" will be paid for at their respective contract unit prices per square yard as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, materials and equipment, including reinforcing steel, dowels, joint material, and other incidentals required to finish the work, complete and accepted by the Engineer.

501.05.2 Price Adjustments. Where the average thickness of pavement is deficient in thickness by more than 3/8-inch, but not more than 1 inch, payment will be made at an adjusted price as specified in the following table:

Concrete Pavement Deficiency

Deficiency in Thickness Determined by Cores Inches	Proportioned Part of Contract Unit Price Allowed
0 to 3/8	100 percent
3/8 to 1/2	80 percent
1/2 to 5/8	72 percent
5/8 to 3/4	68 percent
3/4 to 7/8	57 percent
7/8 to 1	50 percent

When the thickness of pavement or base is deficient by more than one inch and the judgment of the Engineer is that the area of such deficient pavement or base should not be removed and replaced, there will be no payment for the area so-retained.

No additional payment over the contract unit price will be made for any pavement or base which has an average thickness in excess of that shown on the Plans.

SECTION 502

FULL DEPTH CLEANING AND SEALING OF JOINTS AND CRACKS TWO AND ONE HALF (2½) INCHES NOMINAL WIDTH OR LESS IN PORTLAND CEMENT CONCRETE PAVEMENT

502.01 DESCRIPTION. This work consists of performing all operations required for cleaning and sealing cracks and joints in existing Portland cement concrete pavement of 2½-inch nominal width or less at the locations indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

502.02. MATERIALS.

a. Joint Seal. Poured joint seal material shall be hot poured asphalt rubber compound conforming to the requirements of AASHTO M173 and approved by the Engineer.

502.03 CONSTRUCTION METHODS.

502.03.1 Equipment. Equipment shall be subject to the approval of the Engineer and maintained in satisfactory working condition at all times.

a. Cutter. Equipment for reshaping cracks shall be a vertical spindle type cutter.

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

c. Self-propelled Sweeper. A small self-propelled sweeper designed especially for use in cleaning highway and airfield pavements shall be used to remove debris, dirt, and dust from joints or cracks in concrete pavement.

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

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

f. Application System. The joint seal shall be placed by hot extrusion with a wand type instrument. The system shall include a flow control valve which allows all cracks to be filled to refusal.

502.03.2 Preparation of Cracks and Joints. All transverse and longitudinal joints and any cracks shall be sealed. Just prior to sealing, each joint or crack shall be thoroughly cleaned to the full depth of the concrete pavement of all foreign material by compressed air. If accessible, the sides of the joints shall be wire-brushed and cleaned of all debris. The sides of the joints shall be surface dry. Poured joint sealing material shall not be placed unless approved by the Engineer.

All material and debris removed from the joint or crack shall be immediately removed from the pavement surface by means of sweepers or hand brooms before sealing.

No joint sealing shall be allowed until the joints are thoroughly dried or where either frost, snow or ice is present.

502.03.3 Application. The joint seal shall be applied by hot extrusion. All joints or cracks are to be filled to refusal so as to eliminate all voids or entrapped air. The hot seal shall completely fill the joint or crack, such that, after cooling, the level of the sealer will be flush with the pavement surface. Any depression in the seal shall be brought up to the specified limit by the further addition of hot seal.

Care shall be taken in the sealing of the joints or cracks such that the final appearance will present a neat fine line. Overfilling of the joints will not be allowed, and spillage of the sealer should be avoided. All workmanship shall be of the highest quality, and all excess or spilled sealer must be removed from the pavement by approved methods and discarded.

502.04 METHOD OF MEASUREMENT. "Full Depth Cleaning and Sealing of Joints and Cracks Two and One-Half Inches Nominal Width or Less in Portland Cement Concrete Pavement" will be measured by the number of linear feet of sealed joints or cracks actually repaired in accordance with the Plans and/or as directed by the Engineer.

502.05 BASIS OF PAYMENT. The accepted quantity of "Full Depth Cleaning and Sealing of Joints and Cracks Two and One-Half Inches Nominal Width or Less in Portland Cement Concrete Pavement" will be paid for at the contract unit price per linear foot as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, equipment, and all other incidentals required to finish the work, complete and accepted by the Engineer.

SECTION 503

REPAIRING DETERIORATED/DAMAGED JOINTS GREATER THAN TWO AND ONE-HALF (2½) INCHES and LESS THAN OR EQUAL TO EIGHT (8) INCHES NOMINAL WIDTH IN FINISHED PORTLAND CEMENT CONCRETE PAVEMENT

503.01 DESCRIPTION. This work consists of performing all operations required for cleaning, saw cutting, concrete removal, rebuilding, and sealing joints in existing Portland cement concrete pavement that are greater than 2½-inches and less than, or equal to 8 inches nominal width at the locations indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

503.02. MATERIALS.

a. Joint Seal. Poured joint seal material shall be a hot poured asphalt rubber compound conforming to the requirements of AASHTO M173 and approved by the Engineer.

b. Epoxy Resin Bonding Agent. This material shall be an all-purpose, two-part epoxy resin system, conforming to AASHTO M234; Type V and be included on the Department's Approved Materials List.

c. Fast Set Repair Mortar. Fast set repair mortar shall conform to the requirements of ASTM C928 and shall be included on the Department's Approved Materials List. The material shall be used in strict accordance with the manufacturer's recommendations. The Department reserves the right to discontinue the use of any product it deems is not performing to the standards advertised by its manufacturer.

Should the Contractor choose an approved repair material not previously used by the Department, the Contractor shall arrange with the material's manufacturer or distributor for the services of a competent field representative at the work site prior to any mixing of components. The field representative shall instruct the work crews in the proper mixing and application procedures. The field representative shall remain at the job site after work commences and continue to instruct until he/she and the Engineer are satisfied that the crew has mastered the technique of installing the system successfully. The cost of any expense incurred for these services shall be borne by the Contractor.

d. Preformed Bituminous Joint Filler. Preformed bituminous joint filler shall conform to the requirements of AASHTO M33.

503.03 CONSTRUCTION METHODS.

503.03.1 Equipment. Equipment shall be subject to the approval of the Engineer and maintained in satisfactory working condition at all times.

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

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

c. Melting Kettle. The unit shall be either oil or gas-fired, and shall be of the double walled, oil bath type with a power driven mechanical agitator and circulation pump. The kettle shall be equipped with a thermostat to maintain the sealing compound within the range of temperatures specified by the manufacturer and with a suitable mounted thermometer to indicate the temperature of the sealing compound in the kettle. The melting temperature of the sealer will be furnished by the manufacturer, and shall not be exceeded by more than 10°F.

d. Application System. The joint seal shall be placed by hot extrusion with a wand type instrument. The system shall include a flow control valve which allows all cracks to be filed to refusal.

503.03.2 Removal of Existing Concrete.

a. Saw Cutting. A 3/4-inch deep saw cut parallel to the joint shall be made on both sides of the joint a distance of 3 inches back from the edge of the deteriorated concrete.

Care shall be taken to prevent damage to the freshly saw cut edge and the slab reinforcing during the concrete removal operations.

b. Removal. The concrete shall be removed to the full depth of the existing pavement and to a minimum width of 3 inches by a method approved by the Engineer. "Jack Hammers" heavier than the nominal 30-pound class shall not be used. "Chipping Hammers" heavier than the nominal 15-pound class shall not be used to remove concrete from beneath any reinforcing bar. Hand tools such as hammers and chisels shall be provided for removal of final particles of unsound concrete or to achieve the required depth. In no case shall pneumatic tools be placed in direct contact with reinforcing steel. Any "Load Transfer Device" encountered shall be retained, cleaned and left in place if it is still a competent part of the concrete slab. If the load transfer device has failed as determined by the Engineer, it will be removed and disposed.

503.03.3 Preparatory Work. The exposed concrete and reinforcing steel surface shall be free of rust, oil, solvent, grease, dirt, dust, bitumen, loose particles and other foreign matter just prior to the application of the epoxy bonding agent. Care shall be taken not to disturb the gravel subbase or undermine the existing concrete slabs. Any disturbance of the gravel subbase or undermining of the existing concrete slab shall be corrected by the Contractor, at his expense, to the satisfaction of the Engineer.

503.03.4 Joint Filler Placement. Prior to placement of the fast set repair mortar, one, 1-inch or two, 1/2-inch thick lengths of a preformed bituminous joint filler shall be installed in a straight

line perpendicular to the reinforcing steel for the full width of the existing concrete slab(s). The preformed bituminous joint filler shall extend in a plumb vertical direction from the gravel subbase to the surface of the existing concrete slab.

503.03.5 Application of the Epoxy Bonding Agent. An epoxy bonding agent shall be applied to the prepared concrete surface to be repaired with a stiff-bristle broom to a thickness of approximately 20 mils or in accordance with the manufacturer's recommendations. Reinforcing steel shall not be coated with epoxy.

The Contractor shall follow the manufacturer's recommendations for curing the epoxy bonding agent prior to placing the concrete repair material. The repair material should not be placed if the bonding agent has passed the manufacturer's recommended contact time. If the bonding agent has exceeded its contact time, the Contractor shall follow the manufacturer's recommendations for re-application.

An epoxy bonding agent with an extended contact time should be used if required by the timing of concrete placement and/or weather conditions.

503.03.6 Application of Fast Setting Mortar.

a. Application, Mixing and Batching. Application, priming, curing, clean-up and protection of freshly patched areas shall be performed in accordance with applicable manufacturer's recommendations.

Mix no more material than can be placed within the specified working time recommended by the manufacturer. More than one mixing container or device may be utilized provided that enough patching area is prepared ahead and the work crews can place the materials efficiently without wasting the products.

Unless otherwise recommended by the manufacturer, coarse aggregate to be added to the system to produce concrete mix shall be clean, well graded and surface-dry. It shall conform to AASHTO M43 Size 8. Use of crushed limestone will not be permitted.

b. Weather Limitations for Application of the Epoxy Bonding Agent and Fast Setting Mortar. Concrete repair mortar shall not be applied when the ambient temperature is below 45°F and/or in accordance with manufacturer's recommendations.

503.03.7 Sealing Joints. Upon placement and proper curing of the fast set concrete repair mortar, the top 1 inch of preformed bituminous joint filler shall be removed and replaced with a joint sealer. Each joint shall be thoroughly cleaned and dried prior to placement of the sealing compound. Any cleaning required shall be performed by blowing out all dirt, dust or deleterious matter. The hot extruded joint sealing material shall not be placed unless approved by the Engineer.

All material and debris removed from the joint shall be immediately removed from the pavement surface by means of vacuum sweepers or hand brooms before sealing.

The joint seal shall be applied by hot extrusion. All cracks are to be filled to refusal so as to eliminate all voids or entrapped air. The hot seal shall completely fill the joint, such that, after cooling, the level of the sealer will be flush with the pavement surface. Any depression in the seal shall be brought up to the specified limit by the further addition of hot seal.

Care shall be taken in the sealing of the joints such that the final appearance will present a neat fine line. Overfilling of the joints will not be allowed, and spillage of the sealer should be avoided. All workmanship shall be of the highest quality, and all excess or spilled sealer must be removed from the pavement by approved methods and discarded.

No joint sealing shall be allowed until the joints are thoroughly dried or where either frost, snow or ice is present.

Storage of materials shall be in accordance with manufacturer's recommendations.

503.04 METHOD OF MEASUREMENT. "Repairing Deteriorated/Damaged Joints Greater Than Two and One-Half Inches and Less Than or Equal to Eight Inches Nominal Width in Finished Portland Cement Concrete Pavement" will be measured by the number of cubic feet of fast set concrete repair mortar actually placed in the respective repaired joints in accordance with the Plans and/or as directed by the Engineer.

503.05 BASIS OF PAYMENT. The accepted quantity of "Repairing Deteriorated/Damaged Joints Greater Than Two and One-Half Inches and Less Than or Equal to Eight Inches Nominal Width in Finished Portland Cement Concrete Pavement" will be paid for at the contract unit price per cubic foot as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials and equipment, and all other incidentals required to finish the work, complete and accepted by the Engineer.

SECTION 504

PAVEMENT GROOVING

504.01 DESCRIPTION. This work consists of installing grooves in existing concrete pavement at the locations indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

504.02 MATERIALS. Not applicable.

504.03 CONSTRUCTION METHODS.

a. Sealing Joints. Prior to grooving, all joints in the concrete pavement are to be cleaned and sealed. Sealing of joints shall conform to the applicable requirements of either **SECTION 502** or **SECTION 503** of these Specifications.

b. Grooving. The Contractor shall determine the equipment to be used and the methods to be employed to install grooves in the existing pavement. Whatever method is used, the final product must conform to the requirements of the typical groove detail shown in the Plans within the following tolerances.

1.	Groove width:	0.125"	± 0.005"
2.	Groove depth:	0.125"	± 0.05"
3.	Groove spacing:	1.5"	± 0.125"

The entire width of concrete pavement is to be grooved within the limits shown on the Plans. Pavement grooving is to be accomplished while traffic flow is being maintained. After grooving, the entire pavement, including the grooves, is to be thoroughly cleaned of any remaining fine material.

504.04 METHOD OF MEASUREMENT. "Pavement Grooving" will be measured by the number of square yards of pavement actually grooved in accordance with the Plans and/or as directed by the Engineer.

504.05 BASIS OF PAYMENT. The accepted quantity of "Pavement Grooving" will be paid for at the contract unit price per square yard as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials and equipment, and all other incidentals required to finish the work complete and accepted by the Engineer.

a. Sealing Joints. Cleaning and sealing joints will be paid for in accordance with the applicable requirements of either **Subsection 502.05** or **Subsection 503.05** of these Specifications.

SECTION 505

PORTLAND CEMENT CONCRETE BASE COURSE W/CRACK CONTROL 8-INCH EXTRA STRENGTH

505.01 DESCRIPTION. This work consists of constructing a Class X(AE) Portland cement concrete base course, 8 inches thick, for the purpose of providing high early strength in the pavement.

505.02 MATERIALS. Materials shall conform to the applicable requirements of **Subsection 501.02** of these Specifications with the following additional provisions:

a. Reinforcing. 4" x 4" welded wire fabric reinforcing shall conform to the requirements of **Subsection M.05.02.1** of these Specifications.

b. Dowels. Dowels shall be #5 epoxy coated bars, 24 inches long.

505.03 CONSTRUCTION METHODS. Methods of construction shall conform to the applicable requirements of **Subsection 501.03** of these Specifications with the following additional provisions:

a. Crack Control. Control of cracks shall consist of the following:

1. A longitudinal construction joint along the roadway centerlines using a full depth 22 gauge metal plate.

2. Sawed transverse contraction joints 2¾-inches deep and 1/4-inch wide, spaced 20 feet on center (max.), and filled with liquid asphalt.

3. Preformed joint filler, 1/4-inch by 8 inches, along all curbing and existing roadway base match points.

4. Sawing of joints shall commence as soon as the concrete has hardened sufficiently to permit sawing without excessive raveling, usually between 4 to 24 hours. All joints shall be sawed before uncontrolled shrinkage cracking takes place.

b. Connection to Existing Base Course. The new concrete base course shall be connected into existing abutting concrete base course with #5 epoxy coated dowels spaced 18 inches on center. The dowels shall be drilled and grouted into the existing base course as indicated on the Plans.

c. Opening to Traffic. The pavement will not be opened to traffic until it conforms to the requirements of **Subsection 501.03.16** of these Specifications.

505.04 METHOD OF MEASUREMENT. "Portland Cement Concrete Base Course w/Crack Control 8-Inch Extra Strength" will be measured by the number of square yards of pavement actually provided in accordance with the Plans and/or as directed by the Engineer.

505.05 BASIS OF PAYMENT. The accepted quantity of "Portland Cement Concrete Base Course w/Crack Control 8-Inch Extra Strength" will be paid for at the contract unit price per square yard as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, equipment, reinforcement, joints, dowels, drilling and grouting of dowels, saw cutting, liquid asphalt, and other incidentals required to finish the work, complete and accepted by the Engineer.

PART 600

CONCRETE

SECTION 601

PORTLAND CEMENT CONCRETE

601.01 DESCRIPTION. This work consists of furnishing, placing, curing, and finishing Portland cement concrete for bridges, pavements, structures, and incidental construction in accordance with these Specifications, the Special Provisions and Contract Documents. Any modifications of these general requirements will be given in the specific requirement for each item unless otherwise indicated in the Contract Documents.

Concrete shall consist of a homogeneous mixture of Portland cement, coarse aggregate, fine aggregate, air entrainment, water, admixtures and pozzolan (when used), mixed in proportions herein specified.

601.01.1 Classification. Portland cement concrete shall be proportioned with the required cement content for each class and shall be thoroughly mixed to the consistency herein after specified.

Each class of concrete shall be used in that part of the work in which it is called for on the Plans, Proposals, Special Provisions, or where otherwise directed.

The classes of concrete required for the particular work, unless otherwise indicated or superseded by Special Provisions, are shown in Table 1. All concrete mixes are subject to the approval of the Engineer. The minimum compressive strength of each class of concrete shall be as listed in Table 2 or as specified on the Plans.

Various sizes of approved coarse aggregate for the classes of concrete may be combined during the batching operation in the amount of each fraction of aggregate size required to obtain the specified gradation. When testing aggregates to determine compliance with a specified gradation, fractions will be tested separately and combined mathematically or combined mechanically in predetermined proportions, and tested.

Table 1

Class of Concrete	General Classification of Work	
X	Precast Elements:	Highway Bounds, Modular Wall Units, Flared Ends
HP	Structural & Prestressed/Precast Elements:	I-Beams, Cellular Slabs, Box Beams, Cast-in-place Bridge Structures, Box Culverts, Retaining Walls, Backwalls, Beam Seats, Pier Caps, Pier Columns, Diaphragms, Abutment Stems, Pier Stems, Wall Stems, Bridge Decks, Railings, Parapets, End Posts, Bridge Sidewalks, Cast-in-place Piles, Reinforced Overhead Sign Foundations, Miscellaneous Prestressed/Precast Elements.
XX	Precast Elements:	Collars, Catch Basins, Manholes, Drop Inlets, Sumps, Electrical Handholes, Median Barriers, Copings, Pipe.
	Structural Elements:	Reinforced Footings, Approach Slabs.
	Miscellaneous:	Road Pavements, Commercial Driveways, Headwalls, Endwalls, High Capacity Inlets, Road Base, Sidewalks, Residential Driveways.
A	General Use:	Tremie Seals, Fence Post Footings, Guardrail Anchorage, Mast Arm Foundations, Unreinforced Footings, Paved Waterways, Non-specified Use.
Z	Precast Elements:	Curbing, Pipe.
B	General Use:	Void Filler, Thrust Blocks, Class A Bedding.

Note: All concrete shall be air entrained.

601.02 MATERIALS.

601.02.1 Portland Cement. Portland cement shall conform to the requirements of **SECTION M.02; PORTLAND CEMENT CONCRETE,** and be listed on the Department's Approved Materials List.

For bridge projects, one brand of Portland cement shall be furnished and used for all visible portions of a structure, but is not required for interior deck slabs, beams or corresponding elements that are semi-exposed.

The Contractor shall provide suitable means for storing and protecting the cement against dampness. Cement that becomes partially set or contains lumps of caked cement will be rejected.

All Portland cement used shall be supplied from mill silos that have cement which has been tested. A copy of a certified mill test report shall be furnished to the Engineer for the cement being used. Deliveries may be directed to the site or through a regional distribution base. No cement may be used for the project without a Certificate of Compliance issued by the manufacturer.

In addition, the following will be required:

a. The manufacturer's Certificate of Compliance as referenced above and signed by the company representative having legal binding authority shall accompany each shipment of cement. The Certificate of Compliance shall conform to the Department's requirements. Copies of a standard form are available from the Department upon request.

b. Each shipment or truckload thus received will be sampled and tested by the Engineer. If rejected, the degree to which a structure has been affected by the use of this non-conforming product will be assessed and either the removal of the structure or an adjustment in price will be warranted.

c. Under all steps and conditions, delivery shall be made in weatherproofed and sealed transporting equipment. All cement shall be well protected from moisture and contaminants. Any cement which fails to meet any of the requirements mentioned above shall be rejected and removed from the work. Any hydraulic cement stored by the Contractor for a period longer than 60 days shall be retested in accordance with AASHTO M85 by an independent laboratory at the Contractor's expense and approved by the Engineer before being used on the work.

601.02.2 Chemical Admixtures. Previously approved admixtures shall be used when specified or ordered by the Engineer, or may be used at the Contractor's option if approved by the Engineer as described herein.

Admixtures used in Portland cement concrete shall conform to the requirements of **SECTION M.02**. No admixture shall be used in the work unless it is approved by the Engineer.

Physical and chemical properties of admixtures shall be uniform throughout their use in the work. Should it be found that an admixture as furnished is not uniform in properties, its use shall be discontinued.

If more than one admixture type or brand is used, said admixtures shall be compatible with each other so that the desirable effects of all admixtures used will be realized.

When the Contractor proposes to use an admixture of a brand and type on the Department's Approved Materials List, he shall furnish a Certificate of Compliance from the manufacturer, certifying that the admixture furnished conforms to the chemical and physical requirements as specified by the Department. The Engineer may take samples for testing at any time.

The cost of the admixtures, when approved for use, shall be distributed over the appropriate pay items at no extra compensation. The quantity of admixture used shall be in accordance with the manufacturer's recommended minimum and maximum dosage range.

Air-entraining admixture shall be used in amounts to produce a concrete having the specified air-content.

Chemical admixtures, including air-entraining admixtures, shall be dispensed in liquid form. If more than one chemical admixture is used in the concrete mix, a separate dispensing measuring unit shall be provided for each admixture. Dispensing shall be accomplished in accordance with manufacturer's approved recommendations. Dispensers for chemical admixtures shall have sufficient capacity to measure at one time the prescribed quantity required for each batch of concrete. Each dispenser shall include a graduated measuring unit into which liquid admixtures are measured to within plus or minus 2 percent of the prescribed quantity (volume or weight, as applicable) for each batch of concrete. Dispensers shall be located and maintained so that the graduations can be accurately read from the point at which proportioning operations are controlled to permit a visual check of batching accuracy prior to discharge. Each dispensing unit shall be clearly marked for the type and quantity of admixture.

Each liquid admixture dispensing system shall be equipped with a sampling device consisting of a valve located in a safe and readily accessible position such that a sample of the admixture may be withdrawn by the Engineer.

For all types of admixtures the water content as determined by manufacturer's recommendations and/or Departmental testing must be taken into account when calculating the total unit free water of the concrete mix.

601.02.3 Pozzolans. Mineral admixtures such as fly ash, blast furnace slag, and silica fume may be permitted as a partial replacement of Portland cement in any concrete as approved by the Engineer. Mineral admixtures shall conform to the requirements of both **Subsection M.02.06** and **SECTION 602** of these Specifications, and furthermore, shall be listed on the Department's Approved Materials List. The Engineer will evaluate requests of alternate cement/pozzolans combinations in the concrete mix design. The Engineer's evaluation may include laboratory testing, field trial runs and other related work required to determine equivalency with specified materials, mix designs, and performance.

The Contractor shall provide suitable means for storing and protecting the pozzolans against moisture. Pozzolans that become partially hydrated or contain lumps will be rejected.

Handling and storage of all pozzolans shall conform to the requirements listed under **Subsection 601.02.1; Portland Cement**.

The manufacturer's Certificate of Compliance signed by a company representative having legal binding authority shall accompany each shipment of pozzolans.

Any pozzolan stored by the Contractor for a period longer than 60 days shall be retested for compliance with the required specifications by an independent laboratory at the Contractor's expense and approved by the Engineer before being used on the work.

601.02.4 Aggregates. Coarse and Fine Aggregates shall conform to the requirements of **Subsections M.01.05** and **M.02.02**, respectively, of these Specifications.

a. Sources of Aggregates. Aggregates shall be obtained from sources which have been previously tested and approved by the State. Results and information of such tests may be obtained from the Engineer upon request. If the Contractor proposes to obtain aggregates from sources that have not been tested and approved, the Contractor shall:

1. Notify the State three months in advance of use, together with relevant test results in accordance with **SECTIONS M.01** and **M.02**. These tests shall be performed by an AASHTO or CCRL accredited laboratory and signed by a Rhode Island Registered Professional Engineer.

2. Submit report of test results ASTM C295 "Petrographic Examination of Aggregates for Concrete" for the proposed aggregates. This test shall be performed by an independent laboratory and signed by a Rhode Island Registered Professional Engineer.

3. Provide a sufficient quantity of aggregate samples to the Engineer for verification testing three months in advance of use.

4. Assume all costs for sampling and testing, except for the cost of verification testing which shall be borne by the State.

The Contractor's attention is directed to the fact that the above requirements may have a direct impact on project schedules.

All proposed aggregates from sources not previously approved will be tested by the State and must produce concrete which has freeze-thaw durability of 80 percent as determined by the relative dynamic modulus (ASTM C215, Transverse Method) at 300 cycles as tested in accordance with ASTM C666 - Procedure A, as modified by the Department. Copies of modification may be obtained from the Engineer upon request.

Aggregates shall be handled or conveyed from stockpiles or other sources to the batching plant in such manner as to secure a uniform grading of the material.

The batch plant site, layout, equipment and provisions for transporting material shall be such as to assure a continuous supply of material to the work. Stockpiles shall be built up in layers of not more than 3 feet in thickness. Each layer shall be completely in place before beginning the next, which shall not be allowed to "cone" down over the next lower layer.

The Contractor, at his expense, shall provide safe and suitable facilities for obtaining and storing samples of aggregates.

Aggregates from different sources and of different gradings shall not be stockpiled together. Aggregates that have become segregated, mixed with foreign materials, or contaminated by aggregates of different gradings shall not be used. All aggregates produced or handled by hydraulic methods shall be stockpiled or binned for draining at least 12 hours before being batched. Rail shipments requiring more than 12 hours will be accepted as adequate binning only if the car bodies permit free drainage. In case the aggregates contain high or nonuniform moisture content, storage or stockpile periods in excess of 12 hours may be required

by the Engineer. In no event shall the moisture content of the fine aggregate at the time of batching exceed 8 percent of its dry weight.

601.02.5 Water. Water used in mixing and curing of concrete shall be subject to approval and shall conform to **Subsection M.02.07** of these Specifications.

601.03 CONSTRUCTION METHODS.

601.03.1 Proportioning.

a. General. The proportioning of ingredients for each batch shall be that approved by the Engineer as herein specified. All concrete used on State of Rhode Island projects will be air-entrained and have the following air contents:

Coarse Aggregate Designated Size	Percent By Volume (Mix Design Basis)	Air Content Range
3/8"	7.0	6.0 - 9.0
½"	7.0	6.0 - 9.0
3/4"	6.0	5.0 - 8.0
1"	6.0	5.0 - 8.0
1½"	5.5	4.5 - 7.5

The following classes and proportions of materials per cubic yard of concrete shall govern unless otherwise specified or approved:

Table 2

CLASS	X	HP	XX	A	Z	B
Minimum Cement Factor: lbs/cy	705	705+	658	611	564	517
Maximum Cement Factor: lbs/cy Total Cementitious	799	799+	799	799	799	799
Maximum Water/ Cementitious Ratio:	0.40	0.40	0.42	0.44	0.45	0.55
Consistency Range in Slump - inches:*	1-3	3-8++	1-3	1-3	0	1-3
Minimum Compressive Strength:						
7 days, (psi)	3,200	3,200	2,400	2,000	3,200	1,800
28 days, (psi)	5,000	5,000	4,000	3,000	5,000	3,000
Minimum Flexural Strength: Modulus of rupture @ 7 days (psi):	As per Contract requirements.					

* The slump range for tremie seals shall be approximately 6-9 inches. The required slump range shall be approved by the Engineer on a job specific basis.

+ Total cementitious material.

++ The slump range for HP shall be obtained by the addition of ASTM C494 Type F or G - High Range Water Reducing Admixture.

Note 1:

i) In general, with the exception of the Class Z mix, if additional workability is desired the Engineer may allow a slump increase of up to 1 inch if an ASTM C494 Type A - Water Reducing Admixture is used, or an increase of up to 3 inches if an ASTM C494 Type F or G - High Range Water Reducing admixture is used. It shall be the Contractor's responsibility to assure that the required slump is maintained at all times.

ii) ASTM C494 Type F or G - High Range Water Reducing Admixture is required when concrete is to be placed by pumping equipment. Admixtures must be used in accordance with manufacturers' recommended dosages.

Slump shall be determined in accordance with AASHTO T119, and air content in accordance with AASHTO T152. Compressive strength test specimens shall be made and cured in accordance with AASHTO T23 and tested in accordance with AASHTO T22.

b. Design and Approval of Concrete Mixtures. The Contractor shall design the concrete mixtures for each class of concrete specified. The concrete mix components shall be proportioned using the absolute volumes method in accordance with the requirements for each class as specified herein and methods outlined in the American Concrete Institute's "Manual of Concrete Practice," 2000 edition; Standard 211.1, "Recommended Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete"; and Standard 301, "Specifications for Structural Concrete in Buildings - Section 4.2.3.3."

Step 1. Laboratory Testing. At least 60 days prior to production, the Contractor shall submit in writing its concrete mix design on Department forms, and trial batch reports supported by laboratory test data to the Engineer for review.

The trial batch test reports shall include the following information:

(a) Contractor/Testing Laboratory name.

(b) The coarse and fine aggregate gradations and sources.

(c) The fine aggregate finess modulus (FM).

(d) Any other pertinent information (i.e., aggregate specific gravities, unit weights, absorptions, or any other material properties).

(e) Date of mixing.

(f) Mixing equipment and procedures used.

(g) The size of batch in cubic yards.

(h) Weight/volume, type, source/manufacturer of all ingredients used in the mix.

(i) Slump.

(j) The air content of the mix.

(k) Concrete temperature.

(l) Unit weight of fresh concrete.

(m) Curing method, age at time of testing and compressive strength of concrete.

Note: All testing shall conform to the applicable AASHTO and/or ASTM requirements listed in these Specifications.

All concrete mix designs with trial batch test reports shall be signed by a Rhode Island Registered Professional Engineer.

Step 2. Trial Runs. Once the concrete mix design provided by the Contractor has been reviewed and no exception taken by the Engineer, the Contractor will conduct trial runs prior to production using the submitted mix design's component materials and proportions including the amount of admixtures which will be necessary to meet the specifications and produce concrete of the required plasticity, workability, air content, compressive strength, flexural strength, or any other specified concrete property. The Contractor shall conduct the trial runs by employing the concrete batch plant, mixer and handling equipment which the Contractor proposes to use in production. All equipment employed in the batching, mixing, transporting, and testing shall be properly calibrated and meet the requirements listed herein prior to commencement of the trial runs. The Contractor shall attempt to produce concrete using the maximum amount of water and air content specified in the submitted mix design during the trial runs. The Engineer shall be notified by the Contractor at least 48 hours in advance of performing the trial runs so that he can witness the test procedures.

The Contractor's attention is directed to the time required to test trial runs. The Contractor shall be responsible for production of trial runs at a sufficiently early date so that the commencement of the work is not delayed.

Once the concrete temperature, slump and air content are tested and found to be in compliance with the Specifications listed herein, the Engineer shall fabricate compressive strength specimens to be tested at 28 days or earlier as determined by the Engineer.

When all specified concrete parameters have been met, the Engineer shall approve the proposed mix design for production.

The approved mix design proportions will govern during the progress of the work.

No changes in the sources or character of the materials shall be made without approval of the Engineer. New materials shall not be used until a revised mix design and new proportions based on laboratory tests and trial mixes are approved by the Engineer.

601.03.2 Batching Plants and Equipment.

a. General. Equipment and tools necessary for handling materials and performing all parts of the work must meet with the approval of the Engineer as to design, capacity, and

mechanical condition and the equipment must be available sufficiently ahead of the start of construction operations to be examined thoroughly for approval.

The batching plant shall include bins, weighing hoppers, and scales for the fine aggregate and for each size of coarse aggregate. Cement shall be weighed independently on a separate scale. The weighing hopper shall be properly sealed and vented.

b. Bins and Hoppers. Bins and hoppers with adequate separate compartments for fine aggregate and for each size of coarse aggregate shall be provided in the batching plant.

c. Cement Silos. Separate silos or holding bins shall be provided for each cement type and pozzolan. The bins shall protect the cement and pozzolan from rain and moisture.

A log must be maintained showing deliveries which will include the brand, supply, location, type, quantity and date. This log shall be maintained by the Contractor on a weekly basis to fully document the cement on hand. All received cement must conform to the specified quality requirements. This log will also contain data showing the quantitative distribution of all cement used on both private and State projects. Copies of the log will be submitted to the Engineer upon request and attested to by the Contractor or his representative.

d. Discharge Chutes. All discharge chutes shall be arranged so that materials will not lodge or be lost on discharge.

e. Scales. The scales for weighing aggregates and cement shall be either the beam-type or the springless-dial type of standard make and design. They shall be accurate within 0.50 percent throughout the range of use and 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.

When beam-type scales are used, provision, such as a "telltale" dial, shall be made for indicating to the operator that the required load in the weighing is being approached. A device on weighing beams shall indicate critical position clearly. Poises shall be designed to be locked in any position and to prevent unauthorized change. The scale, weigh beam and "telltale" device shall be in full view of the operator while charging the hopper, and he shall have convenient access to all controls.

Scales shall be sealed as often as the Engineer may deem necessary to assure their continued accuracy. The Contractor shall have on hand not less than ten, 50-pound weights for frequent testing of all scales. For each scale, a cradle or platform, approved by the Engineer shall be provided for applying the test weights.

All plant scales and water meters, including truck scales, involved in the plant operation shall be tested at the expense of the Contractor by a commercial scale company as follows:

1. Annually prior to use in State work.

2. At intervals of not more than 60 calendar days.

3. At any time ordered by the Engineer.

Note: Every 60 days, the plant owner must submit to the Engineer a certificate from the commercial scale company making the checks attesting to the accuracy of all plant scales. The certificate must be signed by the technician or a responsible representative of the scale company making the check.

f. Automation and Recordation. Plants producing Portland cement concrete for the State of Rhode Island shall conform to the following plant equipment requirements:

1. Automatic Proportioning. Portland cement concrete shall be produced in batch type mixing plants equipped with approved automatic proportioning devices. Such devices shall include equipment for accurately proportioning batches of the various components of the mixture by weight or volume in the proper sequence. Cement and aggregates shall be proportioned by weight. Water and admixtures shall be proportioned by weight or volume. The batch weights will have to be adjusted periodically to take into account the actual moisture content of the aggregates at time of use. Plants shall be automatically equipped to control the batching sequence and timing of 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 and it shall reproduce the reading of the scale being recorded within ±0.1 percent of scale capacity.

(a) Approved mix design.

(b) Batch weights and storage bins for each size aggregate.

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

(d) Weight of cement and/or pozzolans, and storage silo designation.

(e) Weight or volume of water.

(f) Weight or volume of admixtures.

(g) Date batched.

(h) Time of each batch or load.

(i) Tare zero balance to within ±0.3 percent of scale capacity.

(j) Total size of batch

(k) Name of customer.

(l) Name of project and RI Project Contract Number.

(m) Name of trucker and truck number.

The following information shall be included on the delivery ticket.

(a) Signature of Inspector (Plant).*

(b) Amount of water and/or admixtures added at the point of delivery.

(c) Signature of Inspector (Site).*

* Signatures do not indicate "acceptance" of the material, but only signify that the required inspection/witnessing has been accomplished.

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.

3. Equipment Failure. If at any time the recording devices become inoperative, the plant may be allowed to batch materials for a period of not more than 1 work day from the time of breakdown, if approved by the Engineer. Written permission of the Engineer will be required for periods of operations without automatic proportioning facilities longer than 1 work day. As a condition for continued use with inoperative recording devices the Contractor will be required to manually record all required information on all delivery tickets.

4. 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:

Coarse Aggregate:	±.0 percent of required weight of the total coarse aggregate being weighed.
Fine Aggregate:	±2.0 percent of required weight of the total fine aggregate being weighed.
Portland Cement:	±1.0 percent of required weight of cement being weighed.
Pozzolans:	±1.0 percent of required weight of pozzolans being weighed.
Water:	±.0 percent of required weight or volume of water being weighed.
Admixtures:	±3.0 percent of required weight or volume of each admixture being used.

The total weight of the batch shall not vary more than ±1.0 percent from the theoretical design weight.

601.03.3 Concrete Mixing, Delivery, and Discharge. Concrete may be mixed at the site of construction, at a central point, or in transit mixers, all in accordance with these Specifications.

a. Equipment - Mixers and Agitators. Mixers may be stationary mixers or truck mixers. Agitators may be truck mixers or truck agitators.

Stationary mixers shall be equipped with a metal plate or plates on which are plainly marked the mixing speed of the drum or paddles, and the maximum capacity in terms of the volume of mixed concrete. When used for the complete mixing of concrete, stationary mixers shall be equipped with an acceptable timing device that will not permit the batch to be discharged until the specified mixing time has elapsed.

Each truck mixer or agitator shall have attached thereto in a prominent place a metal plate or plates on which are plainly marked the gross volume of the drum, the capacity of the drum or container in terms of the volume of the mixed concrete, and the minimum and maximum mixing speeds of rotation of the drum, blades, or paddles. When the concrete is truck-mixed the volume of concrete mixed per batch shall not exceed the mixer's nominal capacity as shown on the manufacturer's standard rating plate on the mixer, except that an overload up to 10 percent above the mixer's nominal capacity may be permitted, provided concrete test data for strength, segregation, and uniform consistency are satisfactory, and provided no spillage of concrete takes place.

Truck mixers and agitators shall be equipped with means by which the number of revolutions of the drum, blades, or paddles may be readily verified. Truck mixers must also have a means of measuring the amount of water added during retempering such as a water meter or other method approved by the Engineer.

All stationary and truck mixers shall be capable of combining the ingredients of the concrete within the specified time or number of revolutions specified herein into a thoroughly mixed and uniform mass and of discharging the concrete so that no less than 5 of the 6 requirements shown in AASHTO M157-93 Table A1 shall have been met.

The agitator shall be capable of maintaining the mixed concrete in a thoroughly mixed and uniform mass and of discharging the concrete with a satisfactory degree of uniformity as defined by AASHTO M157-93 Annex A1.

Slump tests of individual samples taken after discharge of approximately 15 percent and 85 percent of the load may be made for a quick check of the probable degree of uniformity. These two samples shall be obtained within an elapsed time of not more than 15 minutes. If these slumps differ more than that specified in AASHTO M157-93 Annex A1, the mixer or agitator shall not be used unless the condition is corrected.

Mixers and agitators shall be examined or weighted routinely as frequently as necessary to detect changes in condition due to accumulations of hardened concrete or mortar and examined to detect wear of blades. When such changes are extensive enough to affect the mixer performance, the proof-tests described in AASHTO M157-93 Annex A1 shall be performed to show whether the correction of deficiencies is required.

b. Mixing and Delivery. Ready-mixed concrete shall be mixed and delivered to the point designated by the Engineer by means of one of the following combinations of operations, central-mixed and truck-mixed concrete.

Agitators and non-agitating equipment shall only be used for delivering pre-mixed concrete.

Mixers and agitators shall be operated within the limits of capacity and speed of rotation designated by the manufacturer of the equipment.

1. Central Mixed Concrete. Concrete that is mixed completely in a stationary mixer and transported to the point of delivery either in a truck agitator, or a truck mixer operating at agitating speed, or in non-agitating equipment approved by the Engineer and meeting the requirements specified herein shall conform to the following: The mixing time shall be counted from the time all the solid materials are in the drum. The batch shall be so charged into the mixer that some water will enter in advance of the cement and aggregate, and all water shall be in the drum by the end of the first one-fourth of the specified mixing time.

Where no mixer performance tests are made, the acceptable mixing time for mixers having capacities of 1 cubic yard or less shall not be less than 1 minute. For mixers of greater capacity, this minimum shall be increased 15 seconds for each cubic yard or fraction thereof of additional capacity. For mixer performance refer to AASHTO M157-93 Annex A1.

2. Truck Mixed Concrete is that which is completely mixed in a truck mixer, 70 to 100 revolutions at the mixing speed designated by the manufacturer, to produce the uniformity of concrete indicated in AASHTO M157-93 Annex A1. Concrete uniformity tests shall be made in accordance with AASHTO M157-93 and if requirements for uniformity of concrete indicated in AASHTO M157-93 Annex A1 are not met with 100 revolutions of mixing, after all ingredients, including water, are in the drum, that mixer shall not be used until the condition is corrected.

When satisfactory performance is found in one truck mixer, the performance of mixers of substantially the same design and condition of blades may be regarded as satisfactory. Additional revolutions of the mixer beyond the number found to produce the required uniformity of concrete shall be at a designated agitating speed.

3. Use of Nonagitating Equipment. Central-mixed concrete may be transported in suitable nonagitating equipment approved by the Engineer. The proportions of the concrete shall be approved by the Engineer and the following limitations shall apply:

Bodies of nonagitating equipment shall be smooth, watertight, metal containers equipped with gates that will permit control of the discharge of the concrete. Covers shall be provided for protection against the weather when required by the Engineer.

The concrete shall be delivered to the site of the work in a thoroughly mixed and uniform mass and discharged with a satisfactory degree of uniformity as prescribed in AASHTO M157-93 Annex A1.

c. Discharge.

1. Time and Rate. The time elapsing from the time water is added to the mix until the concrete is in the forms at the site of the work shall not exceed 90 minutes when hauled in truck-mixers or truck-agitators, or 30 minutes when concrete is hauled by nonagitating equipment. Concrete not discharged into its final place within 90 minutes (30 minutes when using nonagitating

equipment) after batching shall be wasted at no additional expense to the State, even if a retarder is used.

The rate of discharge of mixed concrete from transit mixers or agitators shall be controlled by the speed of rotation of the drum in the discharge direction with the discharge gate fully open. These limits shall not be exceeded.

If the discharge of concrete is accomplished by tilting the body, the surface of the load shall be restrained by a suitable baffle to prevent segregation.

2. Retempering. Retempering concrete by adding water or by other means will not be permitted until after arrival on the job site and only when delivered in truck mixers. Additional water or admixtures may be added to the batch materials and additional mixing performed to increase the slump or air content to meet the specified requirements, if permitted by the Engineer, and provided that:

(a) All these operations are performed within 60 minutes after the initial mixing operation,

(b) The maximum water-cement ratio is not exceeded,

(c) The admixture dosages do not exceed manufacturer's recommendations.

If additional water is to be incorporated into the concrete, the drum shall be revolved not less than 30 revolutions at mixing speed immediately after retempering the concrete and before discharge is commenced.

All admixtures shall be added at the plant. The Engineer may approve chemical admixture (superplasticizers, air entrainment, etc.) adjustments at the job site by means of a metered, pressurized wand with the exception of silica fume. The manufacturer’s recommended dosage shall not be exceeded.

If additional admixtures are incorporated into the concrete, the drum shall be revolved not less than 30-to-60 revolutions at mixing speed immediately after retempering the concrete and before discharge is commenced.

Concrete that is not within the specified slump or air content limits at the time of placement shall not be used. The Contractor shall assume the responsibility of any concrete retempering at the site as permitted by the Engineer. Retempering with admixtures will be permitted only with the approval of the Engineer or when specifically provided for in the Contract.

601.03.4 Limitations of Mixing. No concrete shall be mixed, placed, or finished when the natural light is insufficient, unless an adequate artificial lighting system is operational and approved by the Engineer.

The Contractor, at all times during and immediately after placement, shall protect the concrete from adverse affects of rain.

When there is a probability of air temperature below 35°F, the Contractor shall submit for approval by the Engineer, a cold weather concreting and curing plan detailing the methods and equipment which will be used to assure that the concrete temperature does not fall below 50°F during the first 5 days after placement and shall be considered the protection period. Concrete mixing operations during cold weather shall conform to **Subsection 601.03.5; Cold Weather Concrete**.

Concrete mixing operations during hot weather shall conform to **Subsection 601.03.6; Hot Weather Concrete**.

601.03.5 Cold Weather Concrete. When concreting is authorized by the Engineer during cold weather, the aggregates and/or water may be heated by either steam or dry heat prior to being placed in the mixer. The apparatus used shall heat the mass uniformly and shall be so arranged as to preclude the possible occurrence of overheated areas which might injure the materials. Unless otherwise authorized, the temperature of the mixed concrete shall be not less than 50°F, and not more than 90°F at the time of placing it in the forms.

If the air temperature is 35°F or less at the time of placing concrete, the Engineer may require the water and the aggregates to be heated to not less than 70°F, nor more than 150°F, and be verifiable by a temperature measuring device. No concrete shall be placed on frozen subgrade nor shall frozen aggregates be used in the concrete.

Stockpiled aggregates may be heated by the use of dry heat or steam. Aggregates shall not be heated directly by gas or oil flame or on sheet metal over fire.

When aggregates are heated in bins, steam-coil or water-coil heating, or other methods which will not be detrimental to the aggregates, may be used. The use of live steam on or through binned aggregates will not be permitted without approval by the Engineer.

Sufficient heating devices of a type approved by the Engineer shall be installed under an enclosure or covering, capable of maintaining at all times and under all weather conditions during the protection period, a uniform concrete temperature of not less than 50°F. Heating devices shall be arranged to prevent overheating any areas of forms or concrete. Before any concrete is placed, the enclosure and heating apparatus shall be as nearly complete as the placing of the concrete will permit. The minimum temperature shall be continuously maintained around deposited concrete for a period of 5 days immediately after concrete has been placed and then reduced gradually so the concrete will not be subjected to sudden change in temperature. When permitted by the Engineer, the heating period may be reduced when the concrete units involved will not be subjected to any appreciable bending stress from dead or live load until after seasonal conditions have permitted normal curing.

In general, a steam heating system may be used to supply heat during the protection period. Auxiliary devices such as stoves, covered salamanders with stacks or unit heaters shall be provided for use during the periods required for preheating the forms, reinforcing steel and previously placed concrete to 50°F minimum prior to placing the concrete, during placing of concrete, during the time required for the removal of forms and during the surface finishing operations.

When approved by the Engineer, heat for protection may be supplied by any method which will maintain the required temperature of not less than 50°F. When methods other than live steam

are used, provisions shall be made in the enclosure being heated to maintain a humid condition of sufficient vapor (minimum humidity of 100 percent) content to prevent the moisture in the concrete from being evaporated.

The Contractor shall provide adequate fire protection when heating is in progress and shall maintain watchmen or other attendants to keep heating units in continuous operation. The use of open fires will not be permitted.

When approved by the Engineer, concrete may be protected and cured by the use of insulating materials of sufficient thickness to properly maintain the concrete at the specified minimum temperature. The insulating materials and methods of application shall meet with the approval of the Engineer. In general, the insulating material used on vertical forms shall consist of blankets having a durable liner on the side exposed to the weather. The liners shall be asphalt-bonded to both sides of the insulating mat. The insulation material shall be applied tightly against the wood form with the nailing flanges extending out from the blanket so they can be stapled or battened to the sides of the horizontal or vertical studs, spaced as required. The top of all piers, abutments and like concrete shall be covered with the insulating blanket, tightly secured to prevent loss of heat. Areas around protruding reinforcing which cannot be protected with the insulation blankets shall be first covered with sufficient straw or hay to prevent loss of heat from the concrete. In addition to the above, tarpaulins shall be used as an overall cover on top of such concrete. Failure to attain satisfactory control and results with insulation materials will be cause for rejection.

The Contractor will keep a daily permanent record of the concrete surface temperatures throughout the curing period with the use of a 24-hour temperature recording device (disc or other approved type). The Engineer will retain these records.

During freezing weather, all keyways, anchor bolt holes or other depressions in exposed horizontal concrete surfaces shall be sealed against the admission of water, and any damage to the concrete due to the freezing of water in such depressions shall be repaired if practicable, or the concrete shall be replaced by the Contractor at his expense and as directed by the Engineer.

Although permission may be granted to mix and place concrete under the conditions described above, the Contractor is not relieved of any responsibility for obtaining satisfactory results. Unsatisfactory concrete placed under such conditions shall be removed and replaced at the Contractor's expense.

601.03.6 Hot Weather Concrete. For the purpose of these Specifications, Hot Weather shall be as defined in The American Concrete Institute Manual of Concrete Practice, 1993 Edition. During concreting operations in hot weather, appropriate measures shall be taken to reduce the hazards of increased rate of cement hydration, flash set, loss of water due to evaporation, high concrete ingredient temperatures, and the increased difficulty of concrete placing and finishing. The following requirements shall be met during concrete placement operations in hot weather:

a. Concrete Temperature. The temperature of the concrete at the point of discharge shall not exceed 90°F.

b. Cooling Materials. The Contractor may reduce the temperature of the concrete by cooling one or more of several ingredients. The aggregates may be cooled by fogging, or other suitable means which will not result in a high variation of moisture content within the stockpile. Chipped or crushed ice may be used in the mix as a portion of the mixing water on a pound for pound basis, provided such measure is determined at the time it is placed in the mix.

If used, all ice shall be melted before the batch is discharged from the mixing unit. Water may also be cooled by refrigeration or other means which provide a uniform mixing water temperature.

c. Concrete Placing. Immediately before the concrete is placed, the forms and reinforcement steel shall be cooled by spraying with water. In no case shall there be any standing water in the concrete forms as a result of the spraying procedures. The Contractor shall have sufficient skilled men and adequate equipment to place the concrete without delays which may cause excessive slump loss and evaporation due to over-mixing or exposure before it is placed.

d. Finishing. To prevent thermal and shrinkage cracking resulting from moisture loss, the Contractor may be required to furnish wind screens, to use water fogging, or other approved means of supplying moisture. Finishing operations shall follow as closely as practicable behind the placing operation so that curing may begin as soon as possible.

601.03.7 Testing of Concrete.

a. Process Control of Concrete. In the production and placement of all Portland cement concrete, the Contractor shall be responsible for the process control of all materials during the handling, blending, mixing and placement operations.

The Contractor shall have a competent and experienced concrete technician in charge of the mixing operations and overall quality control. Production control procedures shall be such to insure that the concrete produced complies with these Specifications.

The Contractor shall furnish a minimum of one concrete specimen curing box that meets the requirements of **Subsection 929.03.6c** of these Specifications. The curing box will be used for the curing of acceptance concrete test specimens and it will be required for all classes of concrete.

b. Acceptance Sampling and Testing. The Contractor shall afford the Engineer all reasonable access, without charge, for making necessary checks of the production facilities and securing and furnishing the necessary samples to determine if the concrete is being produced in accordance with the Specifications.

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

Acceptance sampling and testing shall be in accordance with the Rhode Island Department of Transportation Project Schedule for the Sampling, Testing and Certification of

Materials and/or as modified in these Specifications. Sampling and testing shall be in accordance with the applicable requirements as follows:

1. Sampling for temperature, air content, and slump; AASHTO T141.

2. Air Content; AASHTO T152.

3. Slump; AASHTO T119.

4. 7 and 28-Day Compressive Strength; AASHTO T23 and AASHTO T22.

5. Unit Weight and Temperature; AASHTO T121.

Every batch shall be sampled and tested for air content, slump and temperature during concrete placement or production (100-percent sampling and testing).

Random sampling and testing for air content, slump and temperature may be substituted for 100-percent sampling and testing if test results are shown to be within the specification limitations. However, 100-percent sampling and testing will be reinstated if a test result for any random sample is outside the specification limitations for air content, slump, or concrete temperature.

Compressive strength test specimens shall be standard 6" x 12" cylinders unless otherwise approved by the Engineer.

c. 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. Acceptance Plan. The method of taking and making measurements on a sample, for the purpose of determining the acceptability of a Lot of material or construction.

2. Lot. An isolated quantity of material from a single source. A measured amount of construction produced by the same process.

3. Sublot. Equal divisions or portions of a Lot.

4. Random Sample. A sample chosen in such a manner that each increment in the Lot has an equal probability of being selected.

5. Acceptance. As defined in Table 3 - Lot Acceptance Schedule.

6. Rejection. When used in this context "rejection" shall mean remove, dispose and replace at the Contractor's expense, or at the discretion of the Engineers' "rejection" may imply acceptance at a lower price.

7. Batch. A quantity of concrete not exceeding 10 cubic yards produced and delivered.

d. Twenty Eight (28)-Day Concrete Compressive Strength. For a given class of concrete, the portions of a concrete structure constructed during one continuous concrete placement operation shall be called the Lot.

The Lot shall be divided into Sublots when the total quantity of concrete placed for each continuous concrete operation exceeding 150 cubic yards, as such, the Sublot shall represent a quantity of 150 cubic yards or less.

Six cylinders shall be cast for each 150 cubic yards or less of concrete delivered for each class of concrete. The casting of any set of 6 cylinders from the same sample of concrete shall not be permitted. The following procedure shall be used to insure Random Sampling: each quantity of 150 cubic yards or less shall be divided into thirds and 2 cylinders shall be cast from each third.

e. Evaluation. Acceptance for compressive strength will be evaluated relative to compliance with the minimum 28-day compressive strength (f'c) shown on the Plans for each class of concrete produced in accordance with TABLE 3 - Lot Acceptance Schedule.

Three cylinders randomly selected from each set of 6 cylinders representing 150 cubic yards or less of concrete placed shall be tested for 28-day compressive strength.

f. Case A: Lot Quantity of 150 Cubic Yards or Less. When the lot quantities are 150 cubic yards or less, the average 28-day compressive strength of 3 cylinders selected from a set of 6 cylinders and the Range, the difference between the largest and the smallest test result, will be used to calculate the acceptance of the Lot. The following formula will be used to calculate the Lot Acceptance Test Result (LATR).

Formula - A

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

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

Symbols

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

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

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

LATR= Lot acceptance test result.

g. Case B: Lot Quantity Greater Than 150 Cubic Yards. When the Lot quantities are greater than 150 cubic yards, 3 cylinders from each set of 6 cylinders from each Sublot shall be tested for 28-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 Lot. The following formula will be used to calculate the Lot Acceptance Test Result (LATR) relative to the use of Sublots.

Formula - B

$$LATR = \overline{X} = \frac{\overline{X1} + \overline{X2} + \ldots + \overline{X}_n}{n}$$

$$\overline{R} = \frac{R1 + R2 + \ldots + R_n}{n}$$

Symbols

$\overline{X}$ = the mean (average) 28-day compressive strength of a set of 3 cylinders for each Sublot.

$\overline{\overline{X}}$ = the mean (average) of the sum of the average 28-day compressive strength test result of each Sublot.

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

n = number of sets.

Concrete will be evaluated for acceptance in accordance with Table 3 - Lot Acceptance Schedule, on the basis of the calculated Lot Acceptance Test Results (LATR).

Table 3
Lot Acceptance Schedule

Lot Acceptance Test Result (LATR) ($\overline{X}$ or $\overline{\overline{X}}$)	**Pay Factor** (LPF)
Not less than f ' c + 0.21 $\overline{R}$ (or R)	1.00
Not less than f ' c + 0.04 $\overline{R}$ (or R)	0.95
Not less than f ' c - 0.10 $\overline{R}$ (or R)	0.70
For less than f ' c - 0.10 $\overline{R}$ (or R)	0.50

1. f 'c is the 28-day compressive strength specified on the Plans.

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

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

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

The Contractor may elect to remove and dispose any defective material and replace it with new material to avoid a pay factor 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 defective 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 Lot Acceptance Test Results.

h. Independent Assurance Testing. Verification testing shall be performed by the State in accordance with the Rhode Island Department of Transportation publication for the Project Schedule for Sampling, Testing, and Certification of Materials.

601.03.8 Curing.

a. Curing Plan. The Contractor shall submit to the Engineer for approval a plan detailing his scheme for achieving the curing of the concrete for the various structural elements as required by these Specifications. This detailed plan shall include, but is not limited to, the following:

1. Curing method.

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

3. Heat devices, types and location around the structure.

4. Method of monitoring the temperature of hardened concrete.

5. Back up systems as required.

The temperature on the surface of the hardened concrete shall not fall below 50^0F at any time during the first 5 days of curing.

Curing operations on all exposed surfaces shall commence immediately after the placing and finishing operations have been completed. The method of curing selected shall be that allowed under the various concrete items and shall be continued throughout the work unless the Engineer determines that the curing plan results in unsatisfactory concrete curing.

Any changes in the method of curing must be authorized in writing. In all cases in which curing requires the use of water, the curing shall have prior right to all water supply or suppliers. Failure to provide sufficient cover material of whatever kind the Contractor may elect to use, or lack of water to adequately take care of both curing and other requirements, shall be cause for immediate suspension of concreting operations. The concrete shall not be left exposed for more than ½ hour between stages of curing and during the curing period.

All newly placed concrete shall be cured in accordance with the methods set forth in these Specifications.

b. Water Method. The concrete shall be kept continuously wet by the application of water for a minimum period of 7 days after the concrete has been placed.

Cotton mats, rugs or carpets may be used as a curing medium to retain the moisture during the curing period. When cotton mats, rugs or carpets are to be used to retain the moisture, the entire surface of the concrete shall be kept damp by applying water with a nozzle so that the flow is atomized in the form of a mist rather than a spray, until the surface of the concrete is covered with the curing medium. The moisture from the nozzle shall not be applied under pressure directly upon the concrete and shall not be allowed to accumulate on the concrete in a quantity sufficient to cause a flow or wash the surface. At the expiration of the curing period, the concrete surfaces shall be cleared of all curing mediums.

When concrete bridge decks and flat slabs are to be cured without the use of a moisture retaining medium, the entire surface shall be kept damp by the application of water with an atomizing nozzle as specified in the preceding paragraph, until the concrete has set, after which the entire surface of the concrete shall be sprinkled continuously with water for a period of not less than 7 days.

c. Curing Compound Method. Concrete that is treated with any additional coatings or overlays shall not be cured as provided in this Section.

Surfaces of the concrete which are exposed to the air shall be sprayed uniformly with a curing compound.

Curing compound shall be applied at a rate in accordance with the manufacturer's recommendation.

Runs, sags, thin areas, skips, or holidays in the applied curing compound shall be evidence that the application is not satisfactory. If a clear color curing compound is used, a fugitive dye shall be added to the curing compound to insure complete coverage.

Curing compounds shall be applied using power operated atomizing spray equipment. The power operated spraying equipment shall be equipped with an operational pressure gauge and a means of controlling the pressure.

The curing compound shall be applied to the concrete following the surface finishing operation immediately before the moisture sheen disappears from the surface, but before any drying, shrinkage, or craze cracks begin to appear. In the event of any drying or cracking of the surface, application of water with an atomizing nozzle as specified above for the "Water Method," shall be started immediately and shall be continued until application of the compound is started or resumed. However, the compound shall not be applied over any resulting freestanding waters. Should the film of compound be damaged from any cause before the expiration of 7 days after the concrete is placed in the case of structures and 72 hours in the case of pavement, the damaged portion shall be repaired immediately with additional compound.

All curing compounds shall remain sprayable at temperatures above 40^0F. They shall not be diluted or altered in any manner after manufacture.

When the curing compound is shipped in tanks or tank trucks, a shipping invoice shall accompany each load. The invoice shall contain the same information as that required herein for container labels.

Curing compounds may be sampled by the Engineer at the source of supply or at the job site, or at both locations.

The curing compound shall be used within 120 days of its manufacture.

All tests will be conducted in accordance with the latest test methods of the American Society for Testing Materials.

d. Waterproof Membrane Method. The exposed finished surfaces of concrete shall be sprayed with water, using a nozzle that atomizes the flow so that a mist and not a spray is formed, until the concrete has set, after which the curing membrane shall be placed. The curing membrane shall remain in place for a period of not less than 72 hours.

Sheeting material for curing concrete shall conform to the specifications of AASHTO M171 for white reflective materials.

The sheeting material shall be fabricated into sheets of such width as to provide a complete cover for the entire concrete surface. All joints in the sheets shall be securely cemented together in such a manner as to provide a waterproof joint. The joint seams shall have a minimum lap of 6 inches.

The sheets shall be securely weighted down by means satisfactory to the Engineer. No rocks, sand or loose debris shall be used as ballast.

Should any portion of the sheets be broken or damaged before the expiration of 72 hours after being placed, the broken or damaged portions shall be immediately repaired with new sheets properly secured into place.

Sections of membrane which have lost their waterproof qualities or have been damaged to such an extent as to render them unfit for curing the concrete shall not be used.

e. Forms-In-Place Method. Formed surfaces of concrete may be cured by retaining the forms in place. The forms shall remain in place for a minimum period of 7 continuous days after the concrete has been placed, except that for members over 20 inches in least dimension the forms shall remain in place for a minimum period of 5 continuous days. The forms shall be removed no later than 3 weeks maximum.

All joints in the forms and the joints between the end of forms and concrete shall be kept moisture tight during the curing period. Cracks in the forms and cracks between the forms and the concrete shall be resealed by methods subject to the approval of the Engineer.

f. Curing Precast Concrete Members. Precast concrete members shall be cured for not less than 7 days in conformance with "Water Method," steam curing, or by radiant heat at the

option of the Contractor. Steam curing for precast members shall conform to the following provisions:

1. After placement of the concrete, members shall be held for a minimum 4-hour presteaming period. If the ambient air temperature is below 50°F, steam shall be applied during the presteaming period to hold the air surrounding the member at a temperature between 50 and 90°F.

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

3. Enclosures for steam curing shall allow free circulation of steam about the member 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 repair 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°F per hour. The curing temperature throughout the enclosure shall not exceed 150°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 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 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°F until the stress is transferred to the concrete.

7. Initial curing of precast concrete will be considered complete once specified transfer strength is verified by compressive strength test results.

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

If the Contractor proposes to cure by any other special method, the method and its details shall be subject to the approval of the Engineer.

601.03.9 Method for Placement of Portland Cement Concrete by Pumping. Placement of concrete by pumping will be permitted as approved by the Engineer. The equipment shall be so arranged that no vibrations result which might damage freshly placed concrete. Where concrete is conveyed and placed by mechanically applied pressure, the equipment shall be suitable in kind

and adequate in capacity for the work. The operation of the pump shall be such that a continuous stream of concrete without air pockets is produced. To facilitate the continuity of the stream, an elbow is required at the end of the discharge trunkline. When pumping is completed, the concrete remaining in the pipeline, if it is to be used, shall be ejected in such a manner that there will be no contamination of the concrete or separation of the ingredients.

Concrete shall be placed so as to avoid segregation of materials and displacement of reinforcement. Prior to the actual placement of concrete, the Engineer may require the Contractor to demonstrate the capability of the equipment to convey the concrete mixture to maintain the specified quality. No further verification of the equipment's capability will be required unless evidence of nonuniform concrete is observed by the Engineer during placement.

Concrete shall not come in contact with aluminum during conveying and placing operations. The lines shall have a minimum diameter of 5 inches. The specific pumping equipment which the Contractor proposes to use shall be subject to the approval of the Engineer.

All chutes, troughs and pipes shall be kept clean and free from coatings of hardened concrete by thoroughly flushing with water after each run; water used for flushing shall be discarded clear of the concrete already in place.

Dropping concrete a distance of more than 5 feet or depositing a large quantity at any point and running or working it along the forms shall not be permitted.

Special care shall be taken to fill each part of the form by depositing concrete directly in the form as near to its final position as possible, to work the coarser aggregates back from the face of the concrete and to force the concrete under and around the reinforcement. After the concrete has taken its initial set, care shall be exercised to avoid jarring the forms or placing any strain on the ends of projecting reinforcement.

The Contractor shall have the option to submit for approval by the Engineer a "pump" mix design formula of the concrete mixture to be used with the specific pumping equipment. The concrete mixture shall meet the specific requirements of paragraph entitled "Proportioning" for air content, cement factor and slump for the various classes of concrete specified.

601.04 METHOD OF MEASUREMENT. "Portland Cement Concrete" will be measured as provided for in the Specifications and/or Special Provisions for the particular item or items under which it is paid.

601.05 BASIS OF PAYMENT. "Portland Cement Concrete," complete in place and fully accepted, will be paid for as provided in the Specifications covering the particular use. Any Portland cement concrete not otherwise provided for will be paid for under the item of concrete masonry of the class indicated and required. These payments shall 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 Lot of Concrete not fully accepted. This reduction in payment for each Lot will be determined by multiplying the price of the various classes of

concrete per cubic yard, by the pay factor determined in **Subsection 601.03.7; Testing of Concrete**.

SECTION 602

MINERAL ADDITIVES FOR PORTLAND CEMENT CONCRETE

602.01 DESCRIPTION. This Specification covers the requirements for either partial replacement of Portland cement with a mineral additive or as an addition to the minimum specified cement factor. Concrete containing mineral additives shall conform to the applicable requirements of **SECTION 601; PORTLAND CEMENT CONCRETE,** of these Specifications together with the additional provisions set forth below.

602.02 MATERIALS. All material components shall conform to the applicable requirements of **SECTION M.02** of these Specifications and shall also be included on the Department's Approved Materials List.

602.02.1 Mix Design and Approval Process. The mix design and approval process of the Portland cement concrete containing mineral additives shall conform to the provisions of **Subsection 601.03.1** of these Specifications. Some adjustments in yield will have to be made in the mix design to compensate for the different specific gravity of the mineral additive. The water/cement ratio shall be based on a combined weight of Portland cement and the weight of the mineral additive.

602.03 CONSTRUCTION METHODS. Construction methods shall conform to **Subsection 601.03** of these Specifications except as otherwise provided herein.

The Contractor shall furnish a Certificate of Compliance from the manufacturer certifying that the mineral additive being supplied conforms to the chemical and physical requirements as specified by the Department.

No mineral additives shall be added to the concrete at the construction site.

Mineral additives replacement quantities or additions other than those herein specified, shall not be allowed unless specifically called for on the Contract Documents or as authorized by the Engineer.

Separate storage silos will be made available for each mineral additive and they shall be protected from rain and moisture. Unless otherwise noted, mineral additives shall be handled in the same manner as Portland cement.

All storage silos shall be completely empty and clean before any mineral additive is deposited therein unless the silo contains a mineral additive of the same type.

Combinations of mineral admixtures will not be allowed unless called for in the Contract Documents or as approved by the Engineer. When allowed, combined mineral admixtures shall be compatible and approved by their respective manufacturers.

602.03.1 Fly Ash. Fly ash shall be substituted or added to Portland cement in the amounts specified in the Contract Documents. If no quantity has been so-specified the Contractor has the option of substituting fly ash for Portland cement up to 15 percent by weight on a 1-to-1 ratio.

Fly ash is not permitted in Class X(AE) concrete.

Fly ash shall not be substituted for Portland cement after October 15th and prior to March 15th.

The fly ash supplier shall maintain a quality control program open for inspection by the State as deemed by the Engineer.

602.03.2 Microsilica. Microsilica shall be substituted or added to Portland cement in the amounts specified in the Contract Documents. If the use of microsilica is specified by the Engineer but no quantity has been listed in the Contract Documents the microsilica content shall be 7 percent by weight of Portland cement on a 1-to-1 ratio.

Any Portland cement concrete mix containing microsilica shall not exceed a water/cement ratio of 0.40.

Only one brand of microsilica shall be supplied for the life of the Contract. If the microsilica is supplied in slurry form it shall be agitated as necessary to prevent separation.

a. Sampling Microsilica Additive. A sample of microsilica additive shall be taken by the Engineer directly from the storage container at the batch plant. If the microsilica is supplied in slurry form, approximately 1 gallon shall be allowed to flow out before the actual sample is obtained. The initial gallon may be placed back into the storage container. The actual sample shall be placed directly into a clean and dry one quart plastic jar furnished by the State. A sample of the microsilica admixture shall be obtained for each production day. The Contractor shall provide the Engineer with an inventory list from the manufacturer of the microsilica additive for all shipments received.

602.03.3 Ground Granulated Blast Furnace Slag. Ground granulated blast furnace slag shall be substituted or added to Portland cement in the amounts specified in the Contract Documents. The use of ground granulated blast furnace slag shall be in accordance with the requirements of **Subsection M.02.06.3** of these Specifications.

Ground granulated blast furnace slag shall not be substituted for Portland cement after October 15th and prior to March 15th.

Ground granulated blast furnace slag is not permitted in Class X(AE) concrete.

Prequalification of a source may be based upon test results by the Department's laboratory or a certified report of test results by a Cement Concrete Reference Laboratory (CCRL) approved

or nationally recognized independent laboratory attesting that the material is in full compliance with these Specifications.

602.04 METHOD OF MEASUREMENT. "Mineral Additives for Portland Cement Concrete" will not be measured for payment.

602.05 BASIS OF PAYMENT. No separate payment will be made for "Mineral Additives for Portland Cement Concrete." Portland cement concrete with mineral additives will be paid for under the appropriate item or items as listed in the Proposal.

SECTION 603

CONTROLLED LOW STRENGTH MATERIAL (CLSM)

603.01 DESCRIPTION. This work consists of furnishing and placing Controlled Low Strength Material (CLSM) as a self consolidating, self leveling, rigid setting, low density material to be substituted for compacted gravel, structural fill, and any incidental construction directed by the Engineer, all in accordance with these Specifications. Any modifications of these general requirements will be provided in the specific requirements for each item unless otherwise indicated in the Contract Documents.

CLSM consists of a homogenous mixture of Portland cement, fine aggregate, water, admixtures (when used) and pozzolanic material (when used), mixed in proportions to attain the properties herein specified. The Contractor must acquaint himself with the kind and type of CLSM required before submitting the mix design.

603.01.1 Classification. There are two main categories for CLSM, excavatable and non-excavatable. The consistency of these two main categories can be further subdivided as flowable and very flowable. Each classification required for the particular work, unless otherwise indicated or superseded by the Contract Documents, is shown in Table 1.

Table I

Description	Flowable	Very Flowable
Excavatable	I	II
Non-excavatable	III	IV

a. Definitions.

1. Very Flowable. Exhibit characteristics needed for small or confined areas and required to flow over long distances.

2. Flowable. Where the above flowability characteristics are not required.

3. Class I and II. Excavatable, that may be removed in the future if required, may be used (but not limited to) in types of applications such as backfill; void filler; fill around manholes and catch basins; utility cut backfill.

4. Class III and IV. Non-excavatable, used in areas not expected to be removed in the future, such as (but not limited to) fill between median barriers; under approach slabs; mat foundations.

603.02 MATERIALS. Materials shall conform to the applicable requirements of **SECTION 601; PORTLAND CEMENT CONCRETE**, of these Specifications unless modified as indicated below.

603.02.1 Chemical Admixtures. In addition to the requirements of **SECTION 601**, the CLSM may contain air entrainment. The amount and type of air entraining admixture is dependent upon the design of the CLSM. The Contractor shall submit the type of air entrainment to be used and specify if an air entrainment admixture is used or if a high range air inducing or foaming type of admixture is used within the mix design.

603.02.2 Coloring Agents. If required by the Engineer, a coloring pigment shall be thoroughly mixed in the CLSM following the utility color code (available thorough Dig Safe). The coloring pigment shall meet the requirements of ASTM C979 and be approved by the Engineer. Coloring pigments shall be used in accordance with the manufacturer's recommendations.

603.02.3 Pozzolans. In addition to the requirements of **SECTION 602**, the pozzolan material, if used, shall consist of, but not be limited to, Fly Ash Type F meeting the requirements of ASTM C618 including the supplemental chemical and physical requirements. The use of high or low carbon content (i.e., loss of ignition) fly ash may be allowed if submitted for approval to the Engineer on a project specific basis by the Contractor. Lime (CaO) content shall be less than 10 percent by weight for Classes I and II.

603.03 CONSTRUCTION METHODS.

603.03.1 General. The CLSM shall be produced and delivered by a Department approved ready-mix concrete supplier familiar with the design, production, and transport of CLSM. The Contractor shall follow the guidelines set forth in ACI 229R-94 Report "Controlled Low Strength Materials (CLSM)" except that the Engineer will not allow the use of non-standard materials (Section 3.7 of ACI Report). The methods and tolerances shall conform to the applicable requirements of **SECTION 601** of these Specifications unless modified herein.

603.03.2 Proportions.

a. General. The CLSM shall be designed to conform to the following end resultant properties (AASHTO test method referenced if applicable):

Modified Slump; performed in accordance with Para. b, below:	Class I and III: 6" to 8" diameter; Class II and IV: 9" to 14" diameter.
Air Content (T 152):	0 percent to 35 percent* (see below)

Unit weight (T 121):	±5.0 pcf from that stated on mix design.

* The CLSM can contain a specific fly ash amount, a high range or foaming type air entraining admixture or other types of pozzolans. If a high range or foaming type air entrainment admixture is used, the air content shall be a minimum of 20 percent. The maximum air content could be adjusted if it is demonstrated to the Engineer by the Contractor that no deleterious effects would be incurred. The Contractor will be held to the air content stated on the mix design within the following tolerance range:

Air Content, Percent	**Tolerance, Percent**
0 - 10	± 1.5
10.1 - 20.0	± 3.0
> 20	± 5.0

The CLSM shall develop 28-day compressive strength (T22, T23, or T106) as indicated below:

Mix	**Specification Range (Psi)**	**Maximum Psi**
Class I and II	30 - 100	100 at 28 days; 200 at 6 months
Class III and IV	100 - 1200*	1200 at 28 days *

* Specific compressive strength(s) for structural applications will be noted on the Contract Drawings.

b. Modified Slump Test. In lieu of the standard slump test, the following test will be performed: a 3-inch (76 mm) inside diameter by 6-inch (152 mm) long straight tube constructed of a non-porous, non-absorbent material shall be dampened and placed upon a smooth, level, non-porous, non-absorbent surface that is also dampened. The tube shall be held firmly in place; filled with CLSM level to the top of the cylinder (no rodding is required); and struck off until the surface is flush with the top of the cylinder. Carefully clean the bottom perimeter of the cylinder of excess CLSM. The cylinder is then raised in a uniform, vertical, steady uplift manner without any lateral or torsional motions within 3 to 5 seconds. Do not knock material from the sides of the cylinder onto the resultant "pancake." Complete an entire test within 1½ minutes from sample to measurement. The diameter of the "pancake" is measured to the nearest 1/4-inch (6 mm) and the average diameter reported (measure cohesive material only; do not include water caused by segregation).

c. Design and Approval of CLSM Mixtures. The Contractor shall design and obtain approval of CLSM Mixtures in accordance with the applicable requirements of **Subsection 601.03.1** of these Specifications.

603.03.3 Batching Plants and Equipment shall conform to the applicable requirements of **Subsection 601.03.2** of these Specifications.

603.03.4 CLSM Mixing, Delivery, and Discharge. In addition to the requirements of **Subsection 601.03.3** of these Specifications, process control testing shall be performed by the Contractor and

these results shall be submitted on a Certificate of Compliance (COC) that states that all applicable specifications have been met. Testing performed by the Engineer will not relieve the Contractor of this requirement.

603.03.5 Limitations of Mixing. Requirements for limitation of mixing shall conform to **Subsection 601.03.4** of these Specifications.

603.03.6 Cold and Hot Weather CLSM. Requirements for cold and hot weather CLSM shall conform to **Subsections 601.03.5** and **601.03.6**, respectively, of these Specifications.

603.03.7 Curing. The requirements of **Subsection 601.03.8** of these Specifications will apply if there is a probability of the air temperature falling below 40°F and/or the temperature on the surface of the CLSM will fall below 50°F at any time during the first five days after placement. The CLSM shall be protected from freezing until it is hardened. The temperature of the CLSM shall be a minimum of 40°F upon placement. Otherwise, no curing is required.

603.03.8 Testing of CLSM. In addition to the requirements of **Subsection 601.03.7** of these Specifications, for **Para. b; Acceptance Sampling and Testing**, cast six, 4" x 8" cylinders per each day's production and type of mix used (6" x 12" cylinders also acceptable). Rodding of specimen is not required. Once the specimen is full, lightly strike the exterior of the mold 8 to 12 times to consolidate the CLSM. Specimens shall remain in the molds until time of testing. Extreme care shall be exercised in the handling and transportation of CLSM specimens. Age of compressive strengths will be tested at the discretion of the Engineer.

Paras. c, d, e, f, and **g** of **Subsection 601.03.7** do not apply to CLSM.

603.03.9 Plant Field Laboratory. The requirements for Plant Field Laboratory shall conform to **SECTION 930** of these Specifications except for the following which do not apply:

a. Subsection 930.03.1; Bituminous Concrete Mixing Plants.

b. Subsection 930.03.2; Cement Concrete Mixing Plants; the following pieces of testing equipment will not be required:

1. The 45 Kg digital platform beam scale.

2. The gravity drying oven.

3. The Gilson TS-1 sieve shaker.

4. The sample splitter 2½-inch chute width.

c. Subsection 930.03.3; Computer Equipment.

603.03.10 Placing CLSM by Pumping. The requirements for pumping CLSM shall conform to **Subsection 601.03.9** of these Specifications with the following exception: The discharge height may exceed 5 feet and is limited only if the mixture becomes segregated. Pumping may be suspended if the Engineer observes any deleterious materials in the discharge.

The Contractor shall demonstrate the ability to pump CLSM without appreciable loss or consistency of air content.

603.03.11 Traffic/Paving. Resumption of traffic onto CLSM or the asphalt paving over CLSM, when required by the Engineer to expedite the overall operation, will require an initial set time and early strength development. The initial time for the CLSM to set will be a maximum of 3 hours, which time will support the weight of the traffic and/or paving operation without rutting or damage to the CLSM. The Contractor will demonstrate during the mix design approval process that the above condition will be attained.

The Engineer may require the area to be completely covered by steel plating in accordance with details on the Plans or protected in accordance with the latest edition of the MUTCD.

603.03.12 Trench Excavation Limit. For utility or drainage cuts within existing pavement, the excavation limit will be as shown in the Plans and or Special Provisions.

603.04 METHOD OF MEASUREMENT. "Controlled Low Strength Material" will be measured by the number of cubic yards actually placed in accordance with the Plans and/or as directed by the Engineer.

603.05 BASIS OF PAYMENT. The accepted quantity of "Controlled Low Strength Material" will be paid for at the contract unit price per cubic yard as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials and equipment, testing, and all other incidentals required to finish the work, complete and accepted by the Engineer.

SECTION 604

CLASS HP(AE) PORTLAND CEMENT CONCRETE

604.01 DESCRIPTION. Class HP(AE) concrete shall be used for cast-in-place and pre-cast/prestressed concrete bridge structures and shall conform to the applicable requirements of **SECTIONS 601, 602, 814, and 816** of these Specifications, together with the additional provisions set forth below.

604.02 MATERIALS. The concrete mix design for Class HP(AE) concrete shall contain the following additional components:

604.02.1 Liquid Admixtures.

a. Corrosion Inhibitor. Calcium nitrate based corrosion inhibitor shall conform to the requirements of **SECTION 605** of these Specifications.

b. Mineral Additives shall conform to the requirements of **SECTION 602** of these Specifications.

c. Shrinkage Reduction. “Eclipse,” as manufactured by W.R. Grace, or approved equal. Use and dosage rate of admixture will be specified on the Plans.

604.02.2 Synthetic Fibers. Fibers shall be specifically designed to mitigate surface cracking and have the ability to be added to the concrete mix during production. Fiber density shall be a minimum of 50 million individual fibers per pound. Concrete shall be mixed for a minimum of 20 minutes at the required mixing speed once the fibers are added.

604.02.3 Mix Designs. The proportioning of the concrete mix design shall conform to the following guidelines in order to achieve the specified properties:

a. Cast-in-Place Concrete.

Total Cementitious (includes cement, mineral admixture, silica fume M307 and highly reactive pozzolans M321):	705 lbs/cy - 799 lbs/cy
Maximum Water/Cementitious Ratio:	0.40
Corrosion Inhibitor:	4.0 gals/cy
Synthetic Fibers:	1.0 #/cy
Mineral Additives:	
Silica Fume Content	50 #/cy
Fly ash/ground granulated blast furnace slag):	20% of total cementitious by weight
Slump Range:*	3" - 8"
Air Content:	6.5% (±1.5%)
Compressive Strength (28 day min.):	5,000 psi

* As identified in Table 2, Note 1, **Subsection 601.03.1** of these Specifications, the required slump range will be accomplished by the addition of a high range water reducing admixture, ASTM C494 Type F or G.

b. Precast/Prestressed Concrete. The mix-design requirements for Precast/Prestressed Concrete shall conform to the provisions of **Subsections 604.02.2 and 604.02.3 Para. a,** except that the percentage of Mineral Additives shall be 10-20% of total cementitious by weight and the synthetic fibers shall not be required unless specified on the Plans.

604.02.4 Manual Batching. The manual addition of Silica Fume and highly reactive pozzolan bags during the batching operation will be allowed on projects totaling 100 cy or less of Class HP concrete, or on individual placements of 3 cy or less of Class HP concrete. The Engineer will approve the method and monitor the addition of the bags. The concrete producer will record the quantity on the automated batch record.

604.03 CONSTRUCTION METHODS. Construction methods shall conform to the applicable requirements of **Subsections 601.03, 602.03, 814.03 and 816.03** of these Specifications.

604.04 METHOD OF MEASUREMENT. The materials required for "Class HP(AE) Portland Cement Concrete" will not be measured for payment.

604.05 BASIS OF PAYMENT. No separate payment will be made for the materials required for "Class HP(AE) Portland Cement Concrete." This item will be paid for under the appropriate item or items as listed in the Proposal.

SECTION 605

CONCRETE WITH CALCIUM NITRITE BASED CORROSION INHIBITOR

605.01 DESCRIPTION. This Specification covers the requirements for adding a calcium nitrite based corrosion inhibitor to the concrete mix design. Concrete containing this admixture shall conform to the applicable requirements of **PARTS 600 and 800** of these Specifications, together with the additional provisions set forth below.

605.02 MATERIALS. All concrete material components shall conform to the requirements of **SECTION M.02; PORTLAND CEMENT CONCRETE** of these Specifications with the following additional provisions for the corrosion inhibitor.

605.02.1 Calcium Nitrite Based Corrosion Inhibitor shall conform to the requirements of ASTM C494 and shall contain 30 ±2 percent of calcium nitrite by weight. The manufacturer shall submit five years of continuous accelerated corrosion test data on concrete with water-cement ratios equal to, or less than 0.40.

605.02.2 Concrete Mix Design Approval Process. Proportioning of ingredients and the design and approval of mixtures shall conform to the requirements of **Paras. a** and **b** of **Subsection 601.03.1** of these Specifications, together with the following additional provisions:

a. Rate. Calcium nitrite based corrosion inhibitor shall be added at a rate of 4.0 gallons per cubic yard with a tolerance of ±1 percent.

b. Ratio. The maximum water to cementitious by weight ratio shall be 0.40.

605.03 CONSTRUCTION METHODS. Construction methods shall conform to the applicable requirements of **Subsections 601.03, 602.03, 814.03 and 816.03** of these Specifications.

605.03.1 Sampling of Calcium Nitrite Based Corrosion Inhibitor. A sample of calcium nitrite based corrosion inhibitor shall be taken by a Department representative. The sample shall be taken directly from the storage container at the batch plant. Approximately 1 gallon shall be allowed to flow out before the actual sample is obtained. The initial gallon may be placed back into the storage container. The actual sample shall be placed directly into a clean and dry one quart plastic jar furnished by the Department. One sample of the corrosion inhibitor shall be obtained for each day of production.

The Contractor shall supply to the Engineer an inventory list from the manufacturer of the corrosion inhibitor for all shipments received.

605.03.2 Curing Concrete. The curing of concrete with calcium nitrite based corrosion inhibitor shall be in accordance with **Subsection 814.03.8** of these Specifications when used on bridge decks, and in accordance with **Subsection 601.03.8** of these Specifications for all other structural items.

605.04 METHOD OF MEASUREMENT. The corrosion inhibitor admixture required for "Concrete with Calcium Nitrite Based Corrosion Inhibitor" will not be measured for payment.

605.05 BASIS OF PAYMENT. No separate payment will be made for the addition of the corrosion inhibitor admixture required for "Concrete with Calcium Nitrite Based Corrosion Inhibitor." Portland cement concrete with calcium nitrate-based corrosion inhibitor will be paid for under the appropriate item or items as listed in the Proposal.

PART 700

DRAINAGE AND SELECTED UTILITY ACCESSORIES

SECTION 701

CULVERTS AND STORM DRAINS

701.01 DESCRIPTION. This work consists of the construction or reconstruction of culverts and storm drains in reasonably close conformity with the dimensions and details indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

701.02 MATERIALS.

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. Pipe, couplings and fittings shall conform to the applicable requirements of AASHTO M294 together with the following provisions.

1. The Pipe shall be Type S and shall be included in the Department's Approved Materials List.

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

3. Pipe dimensions shall conform to the following requirements:

Nominal Pipe size (in.)	Inside Diameter (in.) Min.	Max.
12	11.6	12.4
18	17.5	18.5
24	23.3	24.7

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

5. Reinforced concrete pipe shall be used at all locations where the nominal pipe size greater than 24 inches is specified.

701.02.2 Metal Pipe. Ductile Iron Pipe and Corrugated Metal Pipe of various types and configurations shall conform to the applicable requirements of **Subsection M.04.02** of these Specifications.

701.02.3 Flared End Sections. Concrete flared end sections shall be manufactured according to the details indicated on the Plans. Concrete shall be Class X(AE) and shall otherwise conform to the applicable requirements of **SECTION 601; PORTLAND CEMENT CONCRETE** of these Specifications. Metal flared end sections shall conform to the requirements of **SECTION M.04; DRAINAGE**.

701.02.4 Inspection of Pipe Materials and Manufacturing Plants. Pipe and pipe materials shall meet the requirements of **SECTION M.04**. Manufacturing plants shall be required to submit a quality control plan for review and approval by the Engineer.

When the location of a plant permits, said plant shall be inspected by the Engineer for compliance with the approved quality control plan and these Specifications.

When the plant location does not permit inspection by the Engineer, pipe materials shall be accepted on the basis of notarized Certificates of Compliance including all the above requirements.

701.02.5 Bedding Materials.

a. Class A Bedding consists of Class B(AE) plain Portland cement concrete that conforms to the applicable requirements of **SECTION 601** of these Specifications.

b. Class B Bedding consists of Gravel Borrow that conforms to the applicable requirements of **Subsection M.01.04** of these Specifications.

c. Class C Bedding consists of crushed stone or crushed or screened gravel that conforms to the applicable requirements of **Subsection M.01.04** of these Specifications.

701.02.6 Portland Cement Mortar. Mortar shall conform to the requirements of **Subsection M.04.03.5** of these Specifications.

701.03 CONSTRUCTION METHODS.

701.03.1 Layout. The engineering layout, whether furnished by the State or the Contractor, shall consist of offset staking of the proposed trench every 50 feet or less from structure to structure. Field conditions may require exceptions as to the distance between stakes. Stakes will be marked with stationing on the pipe line side of the stake parallel to the installation, offset distance on the side opposite the pipe line and depth of cut marked on the side facing the open trench. This information shall be transferred to transverse batter boards every 50 feet with line and grade clearly marked and target set, all as directed by the Engineer.

The Contractor, at his option, may perform pipe layout using the laser beam method. When site conditions preclude the use of traditional survey methods, the Contractor shall use the laser beam method.

"Grade," for the purpose of this Section, shall be defined as the designed invert elevation of all pipelines.

701.03.2 Trench Excavation. Trenches shall be excavated in accordance with the applicable requirements of **SECTION 205** of these Specifications.

701.03.3 Bedding. Pipe bedding shall conform to one of the classes specified above in **Subsection 701.02.5**.

a. Class A bedding shall consist of a continuous concrete cradle constructed in accordance with the details indicated on the Plans.

b. Class B and Class C bedding shall be shaped to fit the bell of the pipe to the height specified. Pipe shall be installed in compacted bedding material at least 12 inches in thickness and pre-shaped to accommodate the bell of the pipe. After the pipe has been installed, the trench shall be backfilled and compacted with bedding material to a height equal to at least one-half the diameter of the pipe or as otherwise directed by the Engineer.

701.03.4 Laying Pipe. The pipe laying shall begin at the downstream end of the pipe line. Bell or groove ends of rigid pipe and outside circumferential laps of flexible pipe shall be placed facing upstream. Flexible pipe shall be placed with longitudinal laps or seams at the sides.

Paved or partially lined pipe shall be laid so that the longitudinal centerline of the paved segment coincides with the flow line.

When elliptical pipe with circular reinforcement or circular pipe with elliptical reinforcement is used, the pipe shall be installed in a position such that the manufacturer's marks designating "top" and "bottom" of the pipe shall be not more than 5 degrees from the vertical plane through the longitudinal axis of the pipe.

701.03.5 Joining Pipe. Rigid pipe may be of bell and spigot or tongue and groove design unless one type is specified. The method of joining pipe sections shall be such that the ends are fully entered and the inner surfaces are reasonably flush and even.

Joints shall be made with (a) Portland cement mortar, (b) Portland cement grout, (c) rubber gaskets, (d) oakum and mortar, (e) oakum and joint compound, by a combination of these types, or any one type, as may be specified.

Mortar joints shall be made with an excess of mortar to form a bead around the outside of the pipe and finished smooth on the inside to the spring line of pipe larger than 30 inches. For grouted joints, molds or runners shall be used to retain the poured grout. Rubber ring gaskets shall be installed so as to form a flexible watertight seal. Where oakum is used, the joint shall be caulked with this material and then sealed with the specified material.

All reinforced concrete pipe 36 inches or greater in diameter are to be installed with both rubber gaskets and a Portland cement mortar joint.

When Portland cement mixtures are used, the completed joints shall be protected against rapid drying by suitable covering material.

Ductile iron pipe shall be firmly joined in accordance with the recommendations of the manufacturer.

Flexible pipe shall be firmly joined by coupling bands as recommended by the manufacturer and approved by the Engineer.

Plastic pipe shall be firmly joined by plastic sleeve couplings, welded to the pipe by the application of an appropriate adhesive as recommended by the manufacturer and approved by the Engineer.

Pipe shall be inspected before any backfill is placed. Any pipe determined by the Engineer to be out of alignment, unduly settled, or damaged shall be taken up and re-laid or replaced at no additional cost to the State.

701.03.6 Smooth Interior Corrugated Polyethylene Pipe. The following requirements apply to this classification of pipe.

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

b. Bedding shall be Class B as defined above in **Subsection 701.02.5**.

c. Trench Excavation. Trench excavation shall conform to the requirements of **SECTION 205** of these Specifications.

1. Where the Engineer determines the excavation to be in an area of high water table, an approved separation filter fabric shall be placed against the bottom and sides of the excavation to completely enclose the bedding material, with a minimum 12-inch overlap, to a minimum height of 12 inches above the top of the pipe. After the bedding material is placed and compacted, the filter fabric shall be lapped to completely enclose the bedding material.

2. The trench shall be excavated to a minimum depth below the specified bottom of the pipe of 4 inches in soil trenches and 6 inches in rock trenches. Class B bedding shall be placed and compacted to a height of one inch above the specified bottom of the pipe. The surface of the bedding shall be shaped to fit the contour of the pipe. The pipe shall be installed and be supported to prevent its movement as the trench is filled and the material compacted. Class B bedding material shall be placed and compacted simultaneously on both sides of the pipe to the spring line. Hand tamping shall be used as needed to fill and compact under the bottom curvature of the pipe. Placement and compaction shall be simultaneous on both sides of the pipe to prevent damage to or movement of the pipe. Class B bedding material shall continue to be placed, in 6-inch compacted lifts, to a minimum of 12 inches above the top of the pipe. The remaining backfill shall be placed in lifts no greater than 6 inches after compaction.

3. With the approval of the Engineer, Controlled Low Strength Material, as defined in **SECTION 603** of these Specifications, may be used above the spring line of the pipe in place of all or any portion of the bedding material above the spring line and the remaining backfill.

d. Trench Protection System. The trench protection system shall be designed to meet acceptable engineering criteria and must be certified by a Rhode Island Registered Professional Engineer. The design shall include any effect of the pipe and on any bedding or backfill material providing support to the pipe, of the movement, including the advancement of a trench box or removal of the trench protection system.

e. Testing. No sooner than 30 days after the completion of the compaction of the backfill, the Contractor, under the direction of the Engineer, shall conduct mandrel testing of the pipe. Testing may be required for up to 25 percent of the total length of pipe. The Engineer shall

determine the actual sections of pipe to be tested. The mandrel shall be rigid steel, with a pulling ring at each end, an odd number of legs (9 legs minimum), and an effective diameter at least 95 percent of the base inside diameter. (The base inside diameter is the nominal pipe size less a 1.5 percent fabrication tolerance.) Any pipe through which the mandrel fails to pass shall be removed and a replacement pipe installed by the Contractor. Removed pipe may be reused as the replacement pipe only when it is deemed by the Engineer to be undamaged. Otherwise, the removed pipe shall be removed from the work site by the Contractor. All costs associated with mandrel testing, including the replacement of deflected pipe and any delays that are incurred shall be borne by the Contractor at no additional cost the State.

701.03.7 Backfilling. After the pipe is installed, the trench shall be backfilled with material in accordance with the applicable requirements of **SECTION 205; TRENCH EXCAVATION,** of these Specifications.

When the top of the pipe is exposed above the top of the trench, embankment material shall be placed and compacted for a distance on each side of the pipe equal to at least twice the horizontal inside diameter of the pipe or 12 feet, whichever is less, and to a minimum height of 3 feet above the pipe. This material shall be placed and compacted simultaneously on both sides of the pipe for the full width of the roadbed all in accordance with the requirements of **SECTION 205**. Construction traffic over the pipe shall not be allowed until 3 feet of compacted backfill is in place over the pipe. Above this elevation, embankment shall be placed and compacted in accordance with **Subsection 202.03.2** of these Specifications.

701.03.8 Replacement of Unsuitable Material. When the Engineer determines that the material at the bottom of trenches is unsuitable for the support of drainage pipes, additional excavation shall be authorized. Unsuitable material shall be removed to a depth not to exceed 3 feet, or as determined by the Engineer. When the unsuitable material has been removed, the bottom of the excavation shall be leveled and refilled with the appropriate class of bedding.

Class B bedding shall be placed in 8-inch lifts and compacted to 90 percent of its maximum dry density in accordance with **Subsection 205.03.5; Backfill and Compaction**, of these Specifications. The final compacted lift in the replacement operation shall be graded to the original design elevation of the bottom of trenches.

701.03.9 Unauthorized Excavation. If the bottom of any trench has been excavated below the grade indicated on the Plans or as directed by the Engineer, it shall be brought back to grade by refilling with a well-compacted bedding material of a type selected by the Engineer.

No payment will be made for unauthorized excavation. The Contractor shall furnish, place, and compact the bedding material used to refill the trench to grade at no additional cost to the State.

701.04 METHOD OF MEASUREMENT.

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, and including “Smooth Interior Corrugated Polyethylene 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.

701.04.2 Flared End Sections. "Flared End Sections" of the various types and sizes will be measured by the number of such units actually installed in accordance with the Plans and/or as directed by the Engineer.

701.04.3 Branch Connections and Elbows. "Branch Connections and Elbows" will be included in the length of measurement for pipe. In certain cases, branches and elbows may be measured by the number of such pieces actually installed in accordance with the Plans and/or as directed by the Engineer.

For purposes of measurement, the end of pipe in closed structures shall be considered to be flush with the inside face of said structures. At masonry headwalls, the end of pipe shall be considered to be flush with the face of headwalls.

701.04.4 Bedding Material.

a. "Class A, B, and C Bedding Material" will be measured by the number of cubic yards of each type of bedding actually placed. When bedding is specified and no measurement method is shown on the Plans, bedding material shall be measured within the horizontal Pay Limits specified for Trench Excavation under **Subsection 205.04.2, Para. a** of these Specifications and vertically from 12 inches below grade to a height of 50 percent of the diameter of the pipe excluding, however, the volume occupied by the pipe.

b. Class A, B, or C bedding material ordered placed to backfill authorized excavation of unsuitable material below grade shall be measured within the horizontal Pay Limits as referenced above and vertically to the depth of excavation authorized and directed by the Engineer.

701.05 BASIS OF PAYMENT.

701.05.1 Culverts and Storm Drains. The accepted quantities of the various types and sizes of "Culverts and Storm Drains" indicated on the Plans will be paid for at the respective contract unit prices per linear foot as listed in the Proposal. The prices so-stated constitute full and complete compensation for all trench excavation (except for Trench Excavation-Rock, Trench Rock Excavation-Mechanical, and excavation of unsuitable material below grade) to a depth equal to the invert of the proposed pipes when bedding material is not required, or to a depth sufficient to receive the appropriate layer of bedding material, of whatever class, when such material is required; for the shaping of either the bottom of the trench or the top of bedding material, whichever the case may be, to receive the bell of the pipe; for all dewatering, including pumping, draining, or bailing; for laying, setting and jointing all pipe, including connections to existing drainage structures or pipes; for placing and compacting backfill; for furnishing, placing and subsequently removing all temporary timber or steel sheeting, bracing or shoring; for the legal disposal of all excess or unsuitable excavated materials; and for all other work and incidentals required to finish the work, complete and accepted by the Engineer.

a. Smooth Interior Corrugated Polyethylene Pipe. The accepted quantities of the various sizes of “Smooth Interior Corrugated Polyethylene Pipe” indicated on the Plans will be paid for at their respective contract unit prices per linear foot as listed in the Proposal. The prices so-stated constitute full and complete compensation for all trench excavation, dewatering, design and employment of trench protection, pipe, couplings, fittings, gaskets, bedding material, filter fabric, backfill, compaction, laying of pipe, post-installation mandrel testing, remedial work,

including all labor, equipment, tools, and all other incidentals required to finish the work, complete and accepted by the Engineer.

b. Trench Excavation-Rock, Trench Rock Excavation-Mechanical. "Trench Excavation-Rock," "Trench Excavation-Mechanical," and excavation of unsuitable material below grade will not be included in the contract unit prices for the various types and sizes of "Culverts and Storm Drains" but will be paid for separately as set forth in **Subsection 205.05.2** of these Specifications.

701.05.2 Flared End Sections. The accepted quantities of the various types and sizes of "Flared End Sections" indicated on the Plans will be paid for at the respective contract unit prices per each such unit as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, materials, and equipment for furnishing and placing said units and for all other incidentals required to finish the work, complete and accepted by the Engineer.

701.05.3 Branch Connections and Elbows. When the Contract Documents so-specify, the accepted quantities of "Branch Connections and Elbows" will be paid for at the respective contract unit prices per each such unit as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, materials, and equipment for furnishing and placing said units and for all other incidentals required to finish the work, complete and accepted by the Engineer.

701.05.4 Bedding Material.

a. Class B bedding material will be paid for under the applicable "Culvert," "Storm Drains," or "Flared End Sections" Proposal items and, therefore, shall 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.

b. The accepted quantities of "Class A Bedding" (plain concrete) and "Class C Bedding" (crushed stone or gravel) will be paid for at the respective contract unit prices per cubic yard as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, materials and equipment for providing such bedding material(s) and for other incidentals required to finish the work, complete and accepted by the Engineer.

SECTION 702

MANHOLES, INLETS, AND CATCH BASINS

702.01 DESCRIPTION. This work consists of the construction, of manholes, inlets, and catch basins in reasonably close conformity with the dimensions and details indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

702.02 MATERIALS.

702.02.1 Masonry Unit Construction.

a. General. Clay Brick, Concrete Masonry Units, Lime, Mortar, Frames, Grates, Covers, and Ladder Rungs shall conform to the applicable requirements of **Subsection M.04.03** of these Specifications.

b. Gravel Borrow. Gravel Borrow shall conform to the requirements of **Subsection M.01.02** of these Specifications.

c. Concrete. Concrete for these structures shall conform to the applicable requirements of **SECTION 601; PORTLAND CEMENT CONCRETE,** of these Specifications.

d. Reinforcing. Reinforcing bars shall conform to the requirements of **Subsection M.05.01; Bar Reinforcement**, of these Specifications.

Wire Fabric reinforcing shall conform to the applicable requirements of **Subsection M.05.02.1; Wire Fabric**, of these Specifications.

e. Inspection of Materials. All materials used in the construction of drainage structures shall be subject to acceptance testing by the Engineer. The Contractor shall provide sufficient time for the Engineer to test and inspect said materials prior to their respective incorporation into the work.

702.02.2 Precast Concrete Construction.

a. General. Precast concrete drainage structures will be considered acceptable alternatives to the corresponding masonry unit structures when the latter are specified in the Contract Documents.

b. Precast Concrete Structures shall conform to the applicable requirements of **SECTIONS 601** and **809; PORTLAND CEMENT CONCRETE** and **PRECAST/PRE-STRESSED STRUCTURE CONCRETE MASONRY**, respectively, of these Specifications.

c. Precast Concrete Catch Basins and Manholes shall be designed and manufactured in accordance with ASTM C478; "Precast Concrete Manhole Sections," with the additional stipulation that the concrete mix design shall be Class XX as set forth in **SECTION 601** of these Specifications.

d. Other Materials. Materials and the inspection of said materials as specified under **Subsection 702.02.1; Paras. a, b, d, and e** of this Section shall apply equally to precast concrete drainage structures.

702.03 CONSTRUCTION METHODS.

702.03.1 Masonry Unit Construction.

a. Location. Drainage structures shall be constructed at the locations indicated on the Plans. If obstructions are encountered at these locations that cannot be conveniently removed,

the Engineer will direct that said structures be constructed at either slightly revised or alternate locations.

b. Excavation. Excavation for drainage structures shall be performed in accordance with the applicable requirements of **SECTION 203; STRUCTURE EXCAVATION AND BACKFILL**, of these Specifications. Excavation shall be made to the required horizontal cross section, as directed by the Engineer, and shall be carried to a sufficient depth to accommodate the concrete bases and/or bedding of the various drainage structures. The bottom of the excavation shall be graded and thoroughly tamped prior to placement of concrete bases.

c. Replacement of Unsuitable Material. When the Engineer determines that the material at the bottom of excavations is unsuitable for the support of drainage structures, additional excavation to remove said material shall be ordered. When the unsuitable material has been removed, the bottom of the excavation shall be hand compacted and refilled with appropriate material as approved by the Engineer.

d. Concrete Bases. Plain concrete bases of certain drainage structures shall be constructed in accordance with the applicable requirements of **Subsection 808.03.2; Footings,** of these Specifications.

e. Restrictions on Certain Masonry Units. Concrete brick will not be allowed as a construction material for drainage structures. Concrete masonry block will only be allowed for the vertical riser portions of structures and will not be allowed in the corbeling portions. Clay brick shall be used for corbeling up to the bottom of metal frames.

f. Precast Concrete Sump. If called for on the Plans for use in wet areas, a precast concrete sump section shall be utilized for standard 4-foot round catch basins.

g. Backfill. After construction of drainage structures has proceeded to their respective full heights, the excavation shall be backfilled and compacted in accordance with **Subsection 203.03.5; Para. c, Common Backfill,** of these Specifications.

h. Unauthorized Excavation. If the bottom of any drainage structure excavation has been carried below the grade indicated on the Plans, or as directed by the Engineer, it shall be brought back to grade by filling with appropriate material as approved by the Engineer.

i. Final Cleanup. Upon completion of construction, each drainage structure shall be cleaned of any accumulation of silt, earth, debris, or foreign matter of whatever kind, and shall be maintained in such condition until final acceptance of the work. Catch basins, manholes and inlets requiring subsequent cleaning through no fault of the Contractor after the obligatory cleaning will be paid for in accordance with **SECTION 708; CLEANING AND FLUSHING PIPES AND DRAINAGE STRUCTURES**, of these Specifications.

702.03.2 Precast Concrete Construction.

a. Testing and Inspection. Precast concrete drainage structure units shall be inspected both at the point of manufacture and at the project site. Any such units exhibiting defects or damage that cannot be corrected to the complete satisfaction of the Engineer shall be removed and replaced by the Contractor at no additional cost to the State.

b. Other Construction Requirements. Construction methods specified under **Subsection 702.03.1; Paras. a, b, c, d, g, h, and i** of this Section shall apply equally to precast concrete drainage structures.

702.04 METHOD OF MEASUREMENT.

702.04.1 Manholes, Catch Basins, and Drop Inlets. New "Manholes," "Catch Basins," and "Drop Inlets" of the various types and sizes, and between zero to 12 feet in depth, all as indicated on the Plans, will be measured by the number of such drainage structures actually installed in accordance with the Plans and/or as directed by the Engineer.

The "Additional Depth of Manholes, Catch Basins and Drop Inlets Over 12 Feet" will be measured by the vertical height in linear feet of drainage structure from the 12-foot depth to the top of the base slab.

702.04.2 Metal Frames and Grates and/or Covers. "Metal Frames and Grates" and "Metal Frames and Covers" of the various types and sizes indicated on the Plans will be measured by the number of such assemblies actually installed in accordance with the Plans and/or as directed by the Engineer.

702.04.3 Precast Concrete Inlet and Apron Stones. "Precast Concrete Inlet Stones" and "Precast Concrete Apron Stones" of the various types indicated on the Plans will be measured by the number of such units actually installed in accordance with the Plans and/or as directed by the Engineer.

702.05 BASIS OF PAYMENT.

702.05.1 Manholes, Catch Basins, and Drop Inlets. The accepted quantities of new "Manholes," "Catch Basins," and "Drop Inlets" of the various types and sizes, and between zero and 12 feet in depth, all as indicated on the Plans, will be paid for at the respective contract unit prices per each such structure as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, materials, and equipment for providing said structures including excavation (except rock excavation), placing and compacting backfill, steps, ½-inch thick cement mortar coating on both the inside and outside wall surfaces (except for precast structures), the legal disposal of all surplus excavated and/or unsuitable material, and all other incidentals required to finish the work, complete and accepted by the Engineer.

The accepted quantities of "Additional Depth of Manholes, Catch Basins and Drop Inlets Over 12 Feet" will be paid for at the contract unit price per vertical linear foot of such additional depths as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, and equipment for providing such additional structure depth, complete and accepted by the Engineer.

702.05.2 Metal Frames and Grates and/or Covers. The accepted quantities of "Metal Frames and Grates" and "Metal Frames and Covers" of the various types and sizes indicated on the Plans will be paid for at the respective contract unit prices per each such assembly as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor,

materials, and equipment for providing said assemblies and for all other incidentals required to finish the work, complete and accepted by the Engineer.

702.05.3 Precast Concrete Inlet and Apron Stones. The accepted quantities of "Precast Concrete Inlet Stones" and "Precast Concrete Apron Stones" of the various types indicated on the Plans will be paid for at the respective contract unit prices per each such unit as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, materials, and equipment for providing said units and for all other incidentals required to finish the work, complete and accepted by the Engineer.

"Structure Excavation-Rock" and "Structure Excavation; Rock-Mechanical" will not be included in the contract unit prices for the various types of drainage structures but will be paid for separately as set forth in **Subsection 203.05.1** of these Specifications.

SECTION 703

UNDERDRAINS AND COMBINATION DRAINS

703.01 DESCRIPTION. This work consists of constructing underdrains and/or combination drains, in reasonably close conformity with the dimensions and details indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

703.02 MATERIALS.

703.02.1 Pipe. Unless otherwise indicated on the Plans, the following types of pipe shall conform to the applicable requirements of **SECTION M.04; DRAINAGE,** of these Specifications.

a. Perforated Concrete Pipe.

b. Perforated Corrugated Aluminum Alloy Underdrain Pipe.

c. Perforated Corrugated Polyethylene Drainage Pipe.

d. Perforated Corrugated Polyvinyl Chloride Pipe.

703.02.2 Filter Fabric. Filter fabric shall be a material suitable for underdrain applications and shall be one of those included on the Department's Approved Materials List.

703.02.3 Inspection of Materials. All materials will be subject to periodic inspection for compliance with approved methods of manufacture. Material samples will be obtained by the Engineer for laboratory testing to determine compliance with Specifications. In addition, material test certificates shall be required. Such inspection of manufacturing plants, materials testing, and certificates shall provide the basis for acceptance of materials.

703.02.4 Filter and Bedding Materials.

a. Filter Stone, Fine Aggregates, and Bedding Stone shall conform to the applicable requirements of **SECTION M.01** of these Specifications.

703.03 CONSTRUCTION METHODS.

703.03.1 General. The specified sizes and types of underdrains and/or combination drains shall be constructed in accordance with the lines and grades shown on the Plans. The various types of pipe shall not be interchanged or interconnected except through the introduction of appropriate manholes or catch basins.

a. Structures. Manholes and catch basins required for underdrain and/or combination drain installation shall conform to the applicable requirements of **SECTION 702; MANHOLES, INLETS, AND CATCH DRAINS**, of these Specifications.

703.03.2 Installation of Pipe.

a. Layout. Layout of pipe shall conform to the requirements of **Subsection 701.03.1** of these Specifications.

b. Trench Excavation. Trenches shall be excavated in accordance with the applicable requirements of **SECTION 205** of these Specifications. Trench excavation shall be carried to the width indicated on the Plans, or as directed by the Engineer, to allow for both the thorough compaction of the bedding and backfill material under and around the pipe. Trench walls shall be either vertical or as near vertical as conditions will permit.

c. Bedding and Filter Fabric. A bedding layer of specified filter stone, fine aggregate, or a filter fabric shall be placed within the trench for its full width and length as indicated on the Plans.

d. Laying Drains. Underdrains and combination drains of the type and size specified shall be embedded firmly in the filter stone.

Perforated pipe shall be placed with the perforations down for underdrains and up for combination drains, and the pipe shall be joined securely with the appropriate coupling fittings or bands.

The upgrade ends of all underdrain pipe shall be closed with plugs to prevent entry of soil materials as approved by the Engineer.

After the pipe installation has been inspected and approved, filter stone shall be placed to the required height above the top of pipe, all as shown on the Plans. Any remaining portion of trench above the filter stone shall be filled with fine aggregate as specified or shown. The fine aggregate shall be compacted using moderate compactive effort by making two passes with a vibratory compactor.

e. Outlets. Outlet pipes shall be placed in trenches with all ends securely jointed by methods recommended by the manufacturer of the particular type of pipe. After inspection and subsequent approval of the outlet pipe installation by the Engineer, the trench shall be backfilled with approved granular material. This material shall be placed in 12-inch layers and compacted with moderate compactive effort by use of approved vibratory equipment.

703.03.3 Unauthorized Excavation. If the bottom of any trench has been excavated below the grade indicated on the Plans, or as directed by the Engineer, it shall be brought back to grade by refilling with a well-compacted bedding material of a type selected by the Engineer.

No payment will be made for unauthorized excavation. Moreover, the Contractor shall furnish, place, and compact the bedding material used to refill the trench to grade at no additional cost to the State.

703.04 METHOD OF MEASUREMENT. "Underdrains" and "Combination Drains" of the various types and sizes indicated on the Plans, together with their respective outlets, will be measured in linear feet of continuous runs of such drains and outlets actually installed in accordance with the Plans and/or as directed by the Engineer.

703.05 BASIS OF PAYMENT. The accepted quantities of the various types and sizes of "Underdrains" and "Combination Drains" will be paid for at their respective contract unit prices per linear foot as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, materials, and equipment for providing said underdrains and combination drains including all trench excavation (except Trench Excavation - Rock and Trench Rock Excavation/Mechanical), bedding, filter stone, filter fabric, placing and compacting backfill, and all other incidentals required to finish the work, complete and accepted by the Engineer.

"Trench Excavation - Rock" and "Trench Rock Excavation/Mechanical" will not be included in the contract unit prices for the various types of underdrains and combination drains but will be paid for separately as set forth in **Subsection 205.05.1** of these Specifications.

SECTION 704

RECONSTRUCT CATCH BASINS AND MANHOLES

704.01 DESCRIPTION. This work consists of reconstructing existing catch basins and manholes in accordance with the dimensions and details indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

704.02 MATERIALS. Materials used in reconstructing existing drainage structures shall conform to the requirements of **Subsection 702.02.1; Masonry Unit Construction**, of these Specifications.

704.03 CONSTRUCTION METHODS. Manholes and catch basins shall be reconstructed in the following sequence: First the structures shall be thoroughly cleaned. Next, the cast iron frames and covers (or grates) are carefully removed and stockpiled on the site for subsequent reuse. Then, the tops of the structure immediately below the castings are removed. Subsequently, a portion of the vertical walls of the structure is removed to a depth sufficient for the reconstructed unit to make the transition to the lines, grades, and dimensions indicated on the Plans, or as directed by the Engineer.

Any excavation required around the existing drainage structure shall be carried out in such manner as to cause the least disturbance to both the surrounding area and those portions of the existing structure that are to remain.

Actual reconstruction of the drainage structures shall then commence in accordance with the details indicated on the Plans or as directed by the Engineer. Construction methods to be employed in this effort shall conform to the applicable requirements as set forth in **Subsection 702.03.1** of these Specifications.

704.04 METHOD OF MEASUREMENT. "Reconstruct Catch Basin and Manhole/Corbel Cones" will be measured by the number of the tops of such units actually reconstructed. "Reconstruct Catch Basin and Manhole/Vertical Walls" will be measured by the vertical height in linear feet of drainage structure walls actually reconstructed in accordance with the Plans and/or as directed by the Engineer.

704.05 BASIS OF PAYMENT. The accepted quantity of "Reconstruct Catch Basin and Manhole/Corbel Cones" will be paid for at the contract unit price per each such cone as listed in the Proposal. The accepted quantity of "Reconstruct Catch Basin and Manhole/Vertical Walls" will be paid for at the contract unit price per vertical linear foot as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, materials and equipment for reconstructing drainage structures including removing, stockpiling and resetting castings, excavation and backfill, examining and cleaning the existing basin before and after reconstruction, the legal disposal of all surplus excavated and/or unsuitable materials, and all other incidentals required to finish the work, complete and accepted by the Engineer.

SECTION 705

RECONSTRUCT EXISTING TYPE "D" CATCH BASIN TO CATCH BASIN WITH GUTTER INLET

705.01 DESCRIPTION. This work consists of reconstructing existing Type "D" catch basins, either square or round, into catch basins with gutter inlet conforming to the details and at the locations indicated on the Plans, or as directed by the Engineer, all in accordance with these Specifications.

705.02 MATERIALS. Materials used in reconstructing existing Type "D" catch basins shall conform to the requirements of **Subsection 702.02.1; Masonry Unit Construction**, of these Specifications.

705.03 CONSTRUCTION METHODS. Catch basins shall be thoroughly cleaned. If repairs are required, they will be made and paid for under the provisions of **SECTION 704; RECONSTRUCT CATCH BASINS AND MANHOLES**, of these Specifications.

The existing granite inlet stones and the existing frames and covers are to be retained if they are in good condition. If the existing granite inlet stones or the existing frames and covers are not in good condition, they shall be replaced and paid for under the applicable provisions of **SECTION 702; MANHOLES, INLETS, AND CATCH BASINS**, of these Specifications. All concrete inlet stones, regardless of condition, shall likewise be replaced.

Actual reconstruction of the Type "D" catch basins shall then commence in accordance with the details indicated on the Plans. Construction methods to be employed shall conform to the applicable requirements as set forth in **Subsection 702.03.1** of these Specifications. In special cases the referenced construction methods may be revised and/or modified by the Engineer.

705.04 METHOD OF MEASUREMENT. "Reconstruct Existing Type "D" Catch Basin to Catch Basin and Gutter Inlet" will be measured by the number of such catch basins actually so-modified in accordance with the Plans and/or as directed by the Engineer.

705.05 BASIS OF PAYMENT. The accepted quantity of "Reconstruct Existing Type "D" Catch Basin to Catch Basin with Gutter Inlet" will be paid for at the contract unit price per each such modified structure as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, and equipment including removing and reconstructing existing walls, excavation, backfill, examining and cleaning the existing basin before and after reconstruction, saw cutting and matching of the full pavement and sidewalk depth, gravel borrow, compaction, concrete and for all other incidentals required to finish the work, complete and accepted by the Engineer.

Furnishing and installing new "Precast Concrete Inlet Stones," "Granite Inlet Stones," "Metal Frames and Grates," and "Metal Frames and Covers" will not be included in the above contract unit prices but will be paid for separately as set forth in **Subsection 702.05** of these Specifications.

"Reconstruct Existing Catch Basins" will not be included in the above contract unit price but will be paid for separately as set forth in **Subsection 704.05** of these Specifications.

SECTION 706

PLUG AND CAP PIPE - ALL SIZES

706.01 DESCRIPTION. This work consists of providing plugs and caps for various sizes and types of pipe at locations indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

706.02 MATERIALS. Plugs and caps for cast iron pipe shall be of the type approved by the utility company for a particular application.

a. Plugs and caps for vitrified clay pipe shall be of the type recommended for this purpose by the manufacturers of said pipe.

b. Cement or brick masonry plugs shall consist of approved cement or brick masonry units securely bedded with cement mortar.

c. Cement mortar shall conform to the requirements of **Subsection M.04.03.5** of these Specifications.

706.03 CONSTRUCTION METHODS. The plugs described above shall be placed in all lines where indicated or directed when such lines are broken into during construction. All such plugs shall produce watertight joints.

Plugs and caps installed in pressure lines shall be properly strapped and blocked to withstand the anticipated back pressure.

Vitrified clay and cement or brick masonry shall be properly and securely set in place, blocked and protected to preclude infiltration or exfiltration due to hydrostatic pressure.

706.04 METHOD OF MEASUREMENT. "Plug and Cap Pipe All Sizes" will be measured by the number of each such unit actually installed regardless of the size or type.

706.05 BASIS OF PAYMENT. The accepted quantity of "Plug and Cap Pipe All Sizes" will be paid for at the contract unit price per each such unit as listed in the Proposal. The price so-stated is full and complete compensation for all labor, materials and equipment required to provide said plugs or caps and for all other incidentals required to finish the work, complete and accepted by the Engineer.

SECTION 707

ADJUST DRAINAGE AND UTILITY STRUCTURES

707.01 DESCRIPTION. This work consists of adjusting existing drainage structures, telephone, electrical, and sanitary manholes to those new grades and details indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

707.02 MATERIALS. Materials shall conform to the applicable paragraphs of **Subsection 702.02.1; Masonry Unit Construction**, of these Specifications.

707.03 CONSTRUCTION METHODS.

707.03.1 General. In addition to the applicable paragraphs of **Subsection 702.03.1** of these Specifications, the following special requirements shall also apply.

When structures are to be adjusted in paved areas, cutting and matching pavement will be required. Cutting and matching pavement will be performed in accordance with **SECTION 932** of these Specifications.

Castings shall be carefully removed and stored and the walls of the structure adjusted to the proper line and grade by the removal or addition of bricks and mortar. Walls shall be plastered with ½-inch cement mortar where required.

Castings shall be reset to the proper line and grade in a bed of mortar. Prior to the placement of the final bituminous concrete course and following the secondary bituminous

concrete course binder, an area of 1 foot outside the top of the frame will be removed to a depth of 9 inches below the surface course. This area will then be compacted and replaced with a Class A(AE) concrete collar to the level of the secondary bituminous course.

Upon completion of each structure it shall be cleaned of any accumulations of silt, debris or foreign matter of any kind and shall be kept clear of such accumulation until basic project acceptance has been achieved. For this specific purpose, basic project acceptance is defined as the successful completion of the 60-day "punch list" period as set forth in **Subsection 105.17, Para. b.4,** of these Specifications.

The Contractor must maintain access to all catch basins and utility manholes at all times.

707.03.2 Narragansett Bay Commission Structures. In addition to the requirements of **Subsection 707.03.1**, the Contractor must obtain a Sewer Facility Permit from the Narragansett Bay Commission prior to removing any frame, cover or grate from any manhole or catch basin and prior to modifying and/or exposing any manhole, catch basin or service connection within the boundaries of the Narragansett Bay Water Quality Management District. The Contractor must strictly adhere to all conditions set forth in the Bay Commission's permit.

707.04 METHOD OF MEASUREMENT. "Adjust Catch Basins," "Adjust Manholes," "Adjust Telephone Manholes," "Adjust Electrical Manholes," "Adjust Sanitary Manholes," and "Adjust Narragansett Bay Commission Sanitary Manholes" will be measured by the number of each type structure actually installed in accordance with the Plans and/or as directed by the Engineer.

707.05 BASIS OF PAYMENT. The accepted quantities of "Adjust Catch Basins," "Adjust Manholes," "Adjust Telephone Manholes," "Adjust Electrical Manholes," "Adjust Sanitary Manholes," and "Adjust Narragansett Bay Commission Sanitary Manholes" will be paid for at the respective contract unit prices per each such structure as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, materials, and equipment required to provide these adjustments including cutting and matching pavement, cement concrete collar, backfilling and disposal of all surplus material and for all other incidentals required to finish the work, complete and accepted by both the Engineer and the representative of the particular utility company involved.

In the case of "Adjust Narragansett Bay Commission Sanitary Manholes," the contract unit price will also include the application fee for the Sewer Facility Permit.

SECTION 708

CLEANING AND FLUSHING PIPES AND DRAINAGE STRUCTURES

708.01 DESCRIPTION. This work consists of cleaning storm drains and drainage structures of all types and sizes as designated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

708.02 MATERIALS.

708.02.1 Equipment. Equipment for cleaning pipe lines includes hoses, rodding machines, balls, hydraulic cleaners, root cutters, small clam shell buckets, steel porcupines, pumps, or other suitable and approved means.

708.02.2 Water. Water used for cleaning and flushing drainage pipes shall be fresh and free of oil, acid, salt, alkali, organic matter, or any other deleterious substances. The Contractor shall provide all water required for the cleaning operation.

708.03 CONSTRUCTION METHODS.

708.03.1 Operation of Drainage System During Cleaning. The Contractor shall be responsible for the proper operation of the storm drainage system during the cleaning operations. The safe control of storm flows shall be accomplished by the Contractor such as to preclude any injury to persons or property due to flooding.

708.03.2 Cleaning Methods. The Contractor shall clean and flush those storm drain lines designated on the Plans by use of pressure hoses, suction pumps, and/or any other methods required to perform this work.

A suitable weir or dam shall be constructed in the nearest downstream manhole or catch basin in such a manner that debris material will be trapped. Under no circumstances shall such material be passed on from one section to the next.

Each manhole or catch basin shall be cleaned independently of other portions of the storm drainage system.

All cleaning work shall be performed to the complete satisfaction of the Engineer.

708.03.3 Disposal of Debris Collected. Disposal of all material collected shall be done in accordance with all requirements of applicable State agencies as described below.

a. Sand and/or Gravel. This debris is sand that may be mixed with salt used on streets, roads or highways for winter storm operations or gravels which have entered the storm drainage system.

1. Acceptable Uses. This material must be dry prior to placement.

(a) Landfill Cover (may require screening).

(b) Road Base, or any base course applicable that will be covered with an asphalt or concrete layer.

(c) Backfill for public works construction projects other than areas adjacent to concrete pipes and structures.

(d) Clean fill, only when analytical testing for Total Petroleum Hydrocarbons (TPH), Toxicity Characteristic Leaching Procedure (TCLP), and Total Lead (TL) have been performed and submitted to RIDEM, Division of Waste Management, for review of reuse application.

2. Unacceptable Uses. As unrestricted clean fill in areas that will expose the debris to human contact such as:

(a) Fill on residential properties, public parks or playground.

(b) Fill near pristine waterways, drinking water watersheds, wellhead protection areas, areas with groundwater classified as GAA, and areas within 200 feet of a private drinking water well, or in any other manner that would be inconsistent with State and Federal laws or regulations.

3. Other Debris. All other debris collected from pipes and structures shall be legally disposed of in accordance with all applicable State agencies laws and regulations.

708.04 METHOD OF MEASUREMENT. "Cleaning and Flushing Pipe - All Sizes" will be measured in linear feet from center-to-center of drainage structures for all pipe lines actually cleaned, regardless of the sizes of said pipe, in accordance with the Plans and/or as directed by the Engineer.

"Cleaning Manholes" and "Cleaning Catch Basins" will be measured by the number of such drainage structures actually cleaned, regardless of size or type, in accordance with the Plans and/or as directed by the Engineer.

708.05 BASIS OF PAYMENT. The accepted quantity of "Cleaning and Flushing Pipe - All Sizes" will be paid for at the contract unit price per linear foot as listed in the Proposal. The accepted quantities of "Cleaning Manholes" and "Cleaning Catch Basins" will be paid for at the respective contract unit prices per each such structure as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, materials, and equipment required to conduct this operation by normal methods, and for all other incidentals required to finish the work, complete and accepted by the Engineer.

SECTION 709

CONCRETE FOR THRUST BLOCKS HEADWALLS AND MISCELLANEOUS PURPOSES

709.01 DESCRIPTION. This work consists of providing Portland cement concrete for thrust and bearing blocks, headwalls, and other miscellaneous purposes at locations designated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

709.02 MATERIALS. The classifications of concrete for thrust blocks, headwalls, and other miscellaneous purposes shall be as set forth in **Table I of Subsection 601.01.1** of these Specifications. Such concrete shall also conform to other applicable requirements of **SECTION 601; PORTLAND CEMENT CONCRETE**, of these Specifications.

709.03 CONSTRUCTION METHODS.

709.03.1 Thrust or Bearing Blocks. Concrete thrust or bearing blocks for backing up tees, bends and hydrants shall be installed at designated locations or as directed by the Engineer. Installation of thrust blocks shall include the placing of concrete and any additional excavation as required. Straps associated with thrust blocks shall likewise be provided.

709.03.2 Headwalls. Concrete construction shall conform to the applicable requirements of **SECTIONS 808** and **702; CAST-IN-PLACE STRUCTURE CONCRETE MASONRY** and **MANHOLES, INLETS AND CATCH BASINS**, respectively, of these Specifications.

709.04 METHOD OF MEASUREMENT. "Concrete" for the purposes specified in this Section will be measured by the number of cubic yards of such material actually placed in accordance with the Plans and/or as directed by the Engineer.

709.05 BASIS OF PAYMENT. The accepted quantity of "Concrete" used for thrust or bearing blocks, headwalls, or for any other miscellaneous purpose will be paid for at their respective contract unit prices per cubic yard as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, materials, and equipment, and all other incidentals required to finish the work, complete and accepted by the Engineer.

SECTION 710

CUT-INS FOR MANHOLES, CATCH BASINS, AND PIPE

710.01 DESCRIPTION. This work consists of cutting into existing manholes, catch basins, and pipe to accommodate new construction at locations indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

710.02 MATERIALS. Materials for brickwork shall conform to the applicable requirements of **Subsection M.04.03.** of these Specifications.

710.03 CONSTRUCTION METHODS.

710.03.1 Manhole and Basin Cut-Ins. The existing manholes and/or catch basins shall be cut into at the grade shown on the Plans. The cut-in shall be made with the approval and acceptance of the Engineer. Overbreakage shall be restricted to not more than 2 inches beyond the outside circumference of the connecting pipe.

Brick shall be laid as headers on edge around the pipe and mortared in place.

Excavation for cut-ins shall be carried out in accordance with the applicable requirements of **SECTION 205; TRENCH EXCAVATION**, of these Specifications.

The outside face of brick walls shall be plastered to a thickness of ½-inch with mortar proportioned as specified herein. Mortar shall be troweled to a smooth hard finish and no backfill shall be placed until the mortar has thoroughly hardened.

710.03.2 Pipe Cut-Ins. Pipe cut-ins shall be made at locations where a new manhole or catch basin is to be inserted on an existing line. Pipe cut-ins shall be performed by either of the following methods:

a. Cutting the Pipe Prior to Performing Any Work in Constructing the New Manhole. In exercising this option, the Contractor shall provide the Engineer with the methods he contemplates on using to maintain the flow or service provided by the pipe to be cut. The Contractor shall receive approval from the Engineer prior to commencing work.

b. Constructing the Manhole on and Around the Pipe Prior to Making the Cutting. Under this method, the Contractor shall excavate around the pipe to the outer limits of the new manhole. The pipe shall be supported and braced in an approved manner to insure against breakage or misalignment that will result in leakage. The Contractor shall obtain approval from the Engineer regarding the method for handling the pipe flow should breakage occur. The manhole invert may be constructed using the lower half of the existing pipe. Jointing between the pipe and manhole wall shall be watertight.

Excavation for pipe cut-ins shall be carried out in accordance with the applicable requirements of **SECTION 203; STRUCTURE EXCAVATION AND BACKFILL**, of these Specifications.

710.04 METHOD OF MEASUREMENT. Not applicable.

710.05 BASIS OF PAYMENT.

710.05.1 Manhole and Catch Basin Cut-Ins. Payment for "Manhole and Catch Basin Cut-Ins" will not be made separately but will be included in the contract unit price per linear foot of the particular pipe involved, as set forth in **SECTION 701; CULVERTS AND STORM DRAINS**, of these Specifications.

710.05.2 Pipe Cut-Ins. Payment for "Pipe Cut-Ins" will not be made separately but will be included in the contract unit price per each of the particular drainage structure involved as set forth in **SECTION 702; MANHOLES, INLETS, AND CATCH BASINS**, of these Specifications.

SECTION 711

PAVED WATERWAYS

711.01 DESCRIPTION. This work consists of constructing paved ditches, flumes, or gutters with cobble stones, Portland cement concrete, bituminous concrete, or other such materials or combinations thereof, in reasonably close conformity with the lines and grades indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

711.02 MATERIALS. Gravel Borrow base shall conform to the requirements of **Subsection M.01.02** of these Specifications.

Concrete shall be Class A(AE) and shall otherwise conform to the applicable requirements of **SECTION 601; PORTLAND CEMENT CONCRETE** of these Specifications.

Bituminous Concrete shall conform to the requirements for Class I-2, surface course material, as set forth in **Subsection M.03.01** of these Specifications.

Cobblestones shall conform to the requirements of **Subsection M.10.05** of these Specifications.

Cement Mortar shall meet the requirements of **Subsection M.04.03.5; Mortar**, of these Specifications.

Bedding Sand shall be natural or manufactured material conforming to the requirements of AASHTO M6.

711.03 CONSTRUCTION METHODS.

711.03.1 Excavation. Excavation for paved waterways shall be carried forth in accordance with the applicable requirements of **SECTIONS 202 or 205** of these Specifications.

711.03.2 Plain Cobble Paving. A layer of bedding sand shall be placed upon a prepared subgrade. This course shall be sufficiently thick to bring the cobblestones, which will be embedded in it, to the proper tamped grade and cross section, all as indicated on the Plans.

The cobblestones shall then be placed. Each stone is to be rammed to an unyielding foundation. The work shall proceed from the sides toward the center, keeping the sides in advance of the center. After the stones have been set, all joints and cavities shall be filled with bedding sand. Stones shall be carefully and thoroughly rammed until no further settlement occurs. During the ramming, the joints shall be kept full of clean fine sand. If, from any cause, the stones shall have been disturbed and left uneven, they must be replaced by the Contractor at no additional cost to the State. The finished surface shall be smooth, even, and reasonably close to the finished line, grade and cross sections.

Concrete headers or stone headers shall be installed in reasonably close conformity to the lines and grades indicated on the Plans, or as directed by the Engineer.

711.03.3 Grouted Cobble Paving. A layer of bedding stone shall be placed upon a prepared subgrade. This course shall be sufficiently thick to bring the stones to the proper grade and cross section. The cobblestones shall then be placed. The work shall proceed from the sides toward the center, keeping the sides in advance of the center. After the stones have been set, all joints and cavities shall be filled with bedding stone to such a height, that after tamping, the joints shall be filled to within 4 inches of the top.

After the stones are thoroughly rammed and at the proper grade, the cement mortar shall be poured and broomed into the spaces between and over the stones. This operation shall be continued until the mortar is flush with the tops of the stones.

Concrete headers or stone headers shall be installed in reasonably close conformity to the lines and grades indicated on the Plans, or as directed by the Engineer.

711.03.4 Bituminous Mixture Paving. A layer of gravel borrow shall be placed upon a prepared subgrade. Unless otherwise indicated on the Plans, this course shall be 6 inches thick such that it conforms to the proper grade and cross section after compaction.

The bituminous mixture shall be spread on the gravel borrow base prepared as herein specified and compacted by tamping or rolling to a finished depth of 3 inches, or such other depth as may be indicated on the Plans. The finished surface shall reasonably conform to the proposed lines, grades and cross sections.

711.03.5 Cement Concrete Paving. A layer of gravel borrow shall be placed upon a prepared subgrade. Unless otherwise indicated on the Plans, this course shall be 6 inches thick such that it conforms to the proper grade and cross section after compaction.

The cement concrete shall be placed on the gravel borrow base to the designated thickness. The finished concrete surface shall reasonably conform to the proposed lines, grades and cross sections. Expansion joints, as required, shall be constructed at the indicated locations and to the required dimensions.

Concrete headers or stone headers shall be installed in reasonably close conformity with the lines and grades indicated on the Plans, or as directed by the Engineer.

711.04 METHOD OF MEASUREMENT. "Paved Waterways" of the various types indicated on the Plans will be measured by the number of square yards of each such type actually provided in accordance with the Plans and/or as directed by the Engineer. (Widths and lengths measured in the horizontal plane.)

711.05 BASIS OF PAYMENT. The accepted quantities of the various types of "Paved Waterways" indicated on the Plans will be paid for at their respective contract unit prices per square yard as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, materials, and equipment including excavation (except "Rock Excavation" or "Rock Excavation/Mechanical"), concrete or stone headers, if required, and for all other incidentals required to finish the work, complete and accepted by the Engineer.

"Trench Excavation - Rock," "Trench Rock Excavation/Mechanical," or "Channel Excavation Rock" will not be included in the contract unit prices for the various types of paved waterways but will be paid for separately as set forth in **SECTIONS 202 or 205** of these Specifications.

SECTION 712

WATER AND GAS GATE BOXES

712.01 DESCRIPTION. This work consists of removing and disposing existing water or gas gate boxes, and subsequently providing new water or gas gate boxes at the locations

indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

712.02 MATERIALS.

712.02.1 Castings. Iron castings shall conform to the requirements of **Subsection M.05.04.9, Para. f**, of these Specifications.

712.02.2 Fabrication. The Contractor shall provide documentation to the effect that water and gas gate boxes conform to the requirements of the respective manufacturers, utility companies and municipalities.

a. Finish. The gate boxes, including covers, shall be thoroughly cleaned and thereafter all surfaces shall be coated, painted or dipped in an asphalt or bituminous base paint or coating.

712.03 CONSTRUCTION METHODS.

712.03.1 Removal of Existing Boxes. The existing gate valve boxes are to be carefully removed so as not to damage or disturb the valves or appurtenant fittings which are to remain. After the gate boxes have been removed, they shall become the property of the Contractor and legally disposed of.

712.03.2 Installation. The boxes shall be set to the proposed line and grade as indicated on the Plans. Once the boxes are set, the Contractor shall take sufficient care not to disturb them. All installations shall be subject to the approval of the applicable gas and/or water company.

The boxes shall be carefully fitted together to the valve and securely held during backfilling. The backfill material shall be thoroughly tamped in place. The boxes shall be constructed as to prevent the separation of the upper section from the lower section and to prevent the upper section from turning when removing the lid.

712.04 METHOD OF MEASUREMENT. "Water Gate Boxes" and "Gas Gate Boxes" will be measured by the number of such assemblies actually installed in accordance with the Plans and/or as directed by the Engineer.

712.05 BASIS OF PAYMENT. The accepted quantities of "Water Gate Boxes" and/or "Gas Gate Boxes" will be paid for at their respective contract unit prices per each such assembly as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, materials, and equipment for providing said assemblies, including removal and disposal of existing gate boxes, excavation, backfill, and all other incidentals required to finish the work, complete and accepted by the Engineer.

SECTION 713

ADJUST CURB STOP, WATER GATE, AND GAS GATE BOXES

713.01 DESCRIPTION. This work consists of adjusting existing utility gate boxes and curb stops to new grades indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

713.02 MATERIALS. Any materials required for the adjustment of boxes shall conform to the applicable paragraphs of **Subsection 712.02**, of these Specifications.

713.03 CONSTRUCTION METHODS. Utility gate boxes and curb stops shall be carefully loosened from the surrounding material and adjusted to the designated new grades. In this regard, the use of gate box adapters will be allowed. The Contractor shall then carefully place approved granular material around the gate boxes and curb stops and hand tamp this material until it is well compacted.

The Contractor must maintain access to the curb stops and utility gate boxes at all times.

When an existing gate box or curb stop is determined by the Engineer not to be adjustable, a new gate box or curb stop will be provided in accordance with the applicable provisions of **SECTION 712; WATER AND GAS GATE BOXES**, of these Specifications. However, if a utility gate box or curb stop is damaged due to improper construction methods, the Contractor shall replace the damaged unit with the corresponding new unit at no additional cost to the State.

713.04 METHOD OF MEASUREMENT. "Adjust Curb Stop Boxes," "Adjust Water Gate Boxes," and "Adjust Gas Gate Boxes" will be measured by the number of such units actually adjusted in accordance with the Plans and/or as directed by the Engineer.

713.05 BASIS OF PAYMENT. The accepted quantities of "Adjust Curb Stop Boxes," "Adjust Water Gate Boxes," and "Adjust Gas Gate Boxes" will be paid for at their respective contract unit prices per each such unit as listed in the Proposal. Each and every adjustment authorized by the Engineer will be paid for. The prices so-stated constitute full and complete compensation for all labor, materials, and equipment including excavation, backfill, compaction, adapter collar and for all other incidentals required to finish the work, complete and accepted by both the Engineer and the representative of the particular utility company involved.

SECTION 714

REMOVE AND RELOCATE POST TYPE HYDRANTS

714.01 DESCRIPTION. This work consists of removing and relocating post type hydrants to locations indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

714.02 MATERIALS. All materials shall meet the applicable requirements established by both the water company that owns the particular system involved and these Specifications.

714.03 CONSTRUCTION METHODS. Existing hydrants shall be carefully removed and transported to the stockpile location as directed by the Engineer. There the hydrants shall be cleaned and made ready for use. Hydrants shall be relocated and installed in accordance with established practices of the water company that owns the particular system involved.

714.04 METHOD OF MEASUREMENT. "Remove and Relocate Post Type Hydrants" will be measured by the number of said hydrants actually installed in accordance with the Plans and/or as directed by the Engineer.

714.05 BASIS OF PAYMENT. The accepted quantity of "Remove and Relocate Post Type Hydrants" will be paid for at the contract unit price per each such unit as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials and equipment, including excavation, backfill, compaction, piping, plugs, testing, thrust blocks, bedding materials and all other incidentals required to finish the work, complete and accepted by the Engineer and the water company.

In the event the relocated hydrant is to be installed over an existing water main, the required tapping sleeve and valve will be paid for separately under the appropriate water service item in the Proposal.

PART 800

BRIDGE STRUCTURES

SECTION 801

GENERAL

801.01 DESCRIPTION.

801.01.1 AASHTO Specifications. Unless otherwise specified, the latest edition of the "STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES," DIVISION II, adopted by the American Association of State Highway and Transportation Officials, together with all current Interim Specifications, shall be considered as part of these Rhode Island Standard Specifications for Road and Bridge Construction, Revision of 2003.

801.02 MATERIALS.

801.02.1 Reports. All material reports shall be submitted under the letterhead of the submitter and/or supplier and should contain the following identifying information:

a. R. I. State Contract Number.

b. Bridge number or numbers involved.

c. Manufacturer's name.

d. Supplier's name.

e. Product identity, name, type, class, lot, drawing number, catalogue number or other reasonably complete identity which will establish the relevance of the submitted reports to the products involved and the date of its manufacture.

f. Shipping identity by bill of lading, including number of pieces, markings, packaging, addressee, shipping date, and route (when no inspection of mill or shop is made).

801.02.2 Mill Reports. It shall be the responsibility of the Contractor to insure the delivery of multiple copies of mill reports, certificates of compliance, tests or other evidence as required by **SECTION 106; CONTROL OF MATERIALS.**

Mill reports shall be prepared in quadruplicate. Unless otherwise prescribed, such reports shall properly attest to manufacturer's production quality control tests reports or comparable tests performed by an approved laboratory. They should include listed test results required by specifications or the test results required by the Standard Designation for establishing the chemical and physical properties of the material.

Certificates of Compliance, when approved by the Engineer in lieu of RIDOT acceptance testing, shall be prepared and submitted in accordance with **Subsection 106.04; Certification of Compliance**, of these Specifications.

801.02.3 Materials Schedule. Sampling, Testing, and Certification of Materials shall be performed in accordance with the "Project Schedule" for each individual project. The "Project Schedule" shall be prepared in accordance with the publication entitled, "Master Schedule for the Preparation of a Project Schedule for Sampling, Testing, and Certification of Materials," latest edition.

801.02.4 Inspection by Others. When State inspection work is contracted to an independent inspection agency, the reports required herein shall be furnished to the representative of that agency.

SECTION 802

TEMPORARY BRIDGES

802.01 DESCRIPTION. This work consists of the construction, maintenance and subsequent removal of temporary bridges at locations indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

802.02 MATERIALS. The materials used for the construction of temporary bridges shall conform to the applicable requirements of **PART M; MATERIALS**, together with the requirements of the current AASHTO Standard Specifications for Highway Bridges, all applicable requirements of these Specifications, the Plans and Special Provisions.

802.03 CONSTRUCTION METHODS.

802.03.1 General. The bridges shall be built in a workmanlike manner in accordance with the Plans, Special Provisions, and applicable requirements of these Specifications.

802.03.2 Approaches. Approach embankments, excavation, surfacing, and other incidental work as specified, shall be provided as necessary to make the temporary structure ready for traffic. The temporary facility shall be completed and opened to traffic prior to any work which might interfere with existing traffic. Temporary safety appurtenances shall be installed on approaches where necessary and as directed by the Engineer for the full protection of vehicular and pedestrian traffic.

802.03.3 Maintenance. The Contractor shall maintain in good condition all temporary structures, approaches, and fills with respect to both safety and rideability until the permanent structure is opened to traffic. Traffic shall be maintained and protected as provided for in **Subsection 104.08; Maintenance of Traffic**. If the Contractor fails to properly maintain the structure, the Engineer shall proceed in accordance with the provisions of **Subsection 105.16; Failure to Maintain Roadway or Structure.**

802.03.4 Removal of Temporary Bridge. On completion of the permanent structure, the Contractor shall remove and legally dispose of the temporary structure. The approach surfaces shall be broken up, the surplus material removed and legally disposed of, and the areas trimmed and graded as specified. Structure removal work shall meet the requirements of **SECTION 803; REMOVAL OF EXISTING BRIDGES**. Materials from the temporary structure shall become the property of the Contractor unless specified otherwise.

802.04 METHOD OF MEASUREMENT. This item does not require a measurement for payment.

802.05 BASIS OF PAYMENT. "Temporary Bridges" will be paid for at the contract lump sum price as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, tools, and equipment, including construction, maintenance, subsequent removal, and area restoration, and all other incidentals required to perform the work, complete and accepted by the Engineer.

802.05.1 Partial Payment. For the purpose of payment, the temporary structure will be considered 75 percent complete when it is available for use and the item will be considered completed when all materials have been removed and the site has been restored.

SECTION 803

REMOVAL OF EXISTING BRIDGES

803.01 DESCRIPTION. This work consists of the removal, in whole or in part, of existing bridges at locations indicated on the Plans or as directed by the Engineer. Removal shall include either the salvage and storage or the legal disposal of resulting materials, together with the restoration of disturbed areas, all in accordance with these Specifications.

803.02 MATERIALS. Not applicable.

803.03 CONSTRUCTION METHODS.

803.03.1 Salvaged Materials. Materials that are designated to be salvaged under provisions of the Contract for subsequent reuse by the Department, and which the Engineer deems suitable for such reuse, shall be carefully removed in sections which may be readily transported. If the Contractor damages or destroys such materials, they will be required to restore or replace them without additional compensation.

Steel superstructures scheduled for reuse shall be dismantled in an approved workmanlike manner, match-marked with paint and carefully removed to avoid damage to any member. The Contractor shall furnish the Engineer a diagram showing the match-marking of all dismantled members.

All structural materials having salvage value and reserved for the State, shall be stored as indicated on the Plans.

803.03.2 Disposable Materials. Unless otherwise indicated on the Plans or directed by the Engineer, all exposed portions of abutments, piers, walls, etc., not to be used as part of the new structure, shall be completely removed to the elevation designated on the Plans.

Materials that are not to be salvaged or stockpiled for reuse by the State shall become the property of the Contractor and shall be removed from the site and legally disposed of in accordance with applicable provisions of **SECTION 201; SITE PREPARATION**.

803.03.3 Partial Removal of Structures. Where portions of existing structures are to remain in service, those portions to be removed shall be removed in such a manner as to leave the structure undamaged and in suitable condition for the contemplated use. Any damage to the portions remaining in service shall be repaired by the Contractor at its expense.

803.03.4 Restoration of Disturbed Areas. Areas disturbed by the removal of existing structures shall be filled with common borrow, as required, to the level of the surrounding ground and compacted in accordance with **Subsection 202.03.3; Compaction**, of these Specifications. The area shall then be graded to blend with adjacent areas and left in a clean and safe condition.

803.04 METHOD OF MEASUREMENT. This item does not require a measurement for payment.

803.05 BASIS OF PAYMENT. "Removal of Existing Bridges" will be paid for at the contract lump sum price as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, tools, and equipment, including removal, salvaging, stockpiling and disposing of materials, restoration of disturbed areas, and all other incidentals required to perform the work, complete and accepted by the Engineer.

SECTION 804

DRIVEN PILES

804.01 DESCRIPTION. This work consists of furnishing and installing foundation piles and trestle piles at the locations indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications. The work shall also conform to the applicable requirements of SECTION 4; DRIVEN FOUNDATION PILES, DIVISION II, of the AASHTO Standard Specifications for Highway Bridges. This work shall also include wave equation analysis, static pile load and dynamic pile testing, preconstruction structure surveys, and vibration monitoring as may be required in the Contract.

804.01.1 Definitions of Driven Piles.

a. Foundation Piles include piles embedded throughout their length below footings or pile caps located below ground surface.

b. Trestle Piles include piles which are exposed for a portion of their length above the ground (or water) surface and below a pile cap or grillage.

All such footings and pile caps shall be constructed according to the provisions of other Sections of these Specifications.

804.01.2 Piles Types Included. Driven piles shall include treated and untreated timber, steel H-section, open-end and closed-end steel pipe, mandrel-driven or self-supporting driven metal shells, precast-prestressed concrete piles, and composite piles consisting of two or more sections of differing materials. Placement of concrete and steel reinforcement in driven shell or pipe piles shall be included in the work of this Specification.

Piles driven for soldier-pile retaining walls shall be furnished and installed under the provisions of **SECTION 805; EARTH RETAINING SYSTEMS** of these Specifications, and are not included in this Specification.

804.01.3 Wave Equation Analyses and Pile Load Testing. The Contractor shall perform and submit a wave equation analysis for each pile type and capacity to be installed, and for each driving hammer and system proposed for use. Where required by the project Plans and Special Provisions, the Contractor shall perform pile load tests in accordance with ASTM D1143, "Piles Under Static Axial Compressive Load," using the quick load compression test method as modified herein. Dynamic pile tests shall be performed in accordance with these Specifications and the Special Provisions.

804.01.4 Pile Lengths. Production piles shall be furnished in sufficient lengths to be driven to the required minimum tip elevations and meet the required driving criteria established by the wave equation analysis, and to the design cut-off elevation. Production pile lengths shown on the Contractor's order list shall generally include only those lengths anticipated for use in the final structure. The Contractor shall furnish, without added compensation, in addition to pile lengths shown or ordered, increased lengths of production or preliminary test piles to provide for fresh heading and such additional pile lengths as may be needed to suit his method of operation.

When preliminary test piles are required in the Contract, production pile lengths shown on the Plans shall be for estimating purposes only. Actual pile lengths to be furnished for production piles will be as required to reach minimum tip elevations and to develop the required capacities, subject to the Engineer's approval after driving preliminary piles. Preliminary piles shall be furnished in lengths greater than the estimated production pile lengths. Such increased pile lengths shall be approved by the Engineer prior to ordering preliminary piles. The Contractor shall drive preliminary test piles at the locations shown on the Plans or as directed by the Engineer to the minimum tip elevations and driving criteria established for production piles. Preliminary piles may be incorporated into the work as permanent piles, if approved by the Engineer.

804.01.5 Defective Piles. The Contractor shall repair or remove and replace any and all improperly installed, broken, damaged, or misaligned piles to the satisfaction of the Engineer at no additional cost to the State.

804.02 MATERIALS.

804.02.1 Treated and Untreated Timber Piles shall conform to the requirements of **Subsections M.07.06** and **M.07.05**, respectively, of these Specifications.

804.02.2 Steel H-Piles shall conform to the requirements of **Subsection M.07.09** of these Specifications.

804.02.3 Open-end and Closed-end Steel Pipe Poles shall conform to the requirements of **Subsection M.07.10** of these Specifications.

804.02.4 Concrete-Filled Shell Piles shall conform to the requirements of **Subsection M.07.08** of these Specifications.

804.02.5 Precast-Prestressed Concrete Piles shall conform to the requirements of **Subsection M.07.07** of these Specifications.

804.02.6 Portland Cement Concrete shall conform to the applicable requirements of **SECTIONS 601** and **M.02**, respectively, of these Specifications.

804.02.7 Steel Reinforcement and Prestressing Steel shall conform to the applicable requirements of **Subsection M.05.01** and **M.05.03**, respectively, of these Specifications.

804.02.8 Steel Closure Plates, Driving Shoes and Points, Lugs, and Splicers shall conform to the applicable requirements of **Subsections M.07.11** and **M.07.12** of these Specifications.

804.02.9 Paint. Paints and undercoats to be applied to steel piles or metal shells shall conform to the requirements of both **SECTION M.06** of these Specifications and Contract Special Provisions.

804.02.10 Wood Preservatives and Treatment. Wood preservatives and treatment methods for treated timber piles shall conform to the applicable requirements of **SECTION M.07** of these Specifications and AASHTO M133; Preservatives and Pressure Treatment Process for Timber.

804.03 CONSTRUCTION METHODS.

804.03.1 Pile Lengths and Order Lists. The Contractor shall furnish piles in accordance with details indicated on the Plans and/or in the Special Provisions.

When preliminary test piles are not specified, the Contractor shall furnish production piles of sufficient length to be driven to the minimum tip elevation and to meet the approved driving criteria determined from the wave equation analysis, and to provide the required cut-off elevation.

In determining the lengths of production piles to be ordered, the lengths indicated in the order list shall be based upon lengths which are assumed to remain in the completed structure. Such pile lengths shall be calculated from the design cut-off elevation to the estimated tip elevation. The Contractor shall, at his own expense, increase the lengths given to provide for fresh heading and for such additional length as may be necessary to suit his method of operation.

When preliminary test piles are specified in the Contract Documents, the Contractor shall furnish and drive piles of lengths and at the locations designated in the Contract Documents. The lengths of production piles indicated on the Plans are for estimating purposes only. Actual production pile lengths to be furnished will be as required to reach minimum tip elevations and to develop required capacities, subject to the approval of the Engineer, after test piles have been driven. Test piles shall be furnished in lengths, subject to the Engineer's approval, greater than the estimated length of production piles, and driven at least to the minimum tip elevations and required capacities established for production piling.

804.03.2 Timber Piles.

a. General. Untreated and treated timber piles shall be stored and handled such as to avoid injury to the piles. Canthooks, dogs, or pike poles shall not be used. Cuts or breaks in the surface of treated piling and bolt holes shall be treated as set forth in these Specifications.

The butt ends of timber piles shall be sawn square to the longitudinal axis of the pile prior to driving. When required in the Plans or as ordered by the Engineer, timber piles shall be further prepared for driving as specified below.

b. Collars, Bands, or Strapping. Collars, bands, or strapping shall be affixed at the butt, intermittently along the length, and near the tip of each pile as shown in the Plans.

c. Trimming and Drive Points. The tips of timber piles shall be sawn square or tapered to a diameter of not less than 4 inches. When required in the Plans, timber piles shall be provided with metal boots or steel point attachments. The Contractor shall suitably trim pile tips to fit the type of boot or point attachment specified.

804.03.3 Precast-Prestressed Concrete Piles.

a. Manufacture. Precast-prestressed concrete piles shall be manufactured to conform to the design and finish shown on the Plans. Concrete for precast/prestressed piles shall conform to the applicable requirements of **SECTION 601** of these Specifications. Precast/prestressed piles, whether plant-produced or manufactured on site, shall be manufactured and prestressed in accordance with both AASHTO Standard Specification; SECTION 10; PRESTRESSING, and **SECTION 809; PRECAST/PRESTRESSED STRUCTURE CONCRETE MASONRY**, of these Specifications.

b. Shape and Minimum Dimensions. Precast/prestressed concrete piles may be either solid piles of rectangular or cylinder section, or hollow cylinder piles. Solid piles may be either of uniform section or tapered. In general, solid precast/prestressed concrete piles shall have a cross-sectional area, measured above the taper of not less than 98 square inches, and where used in salt water or other areas subject to salt intrusion, not less than 140 square inches. The tip diameter or least dimension through the center of precast/prestressed piles shall be not less than 8 inches.

The dimensions and thicknesses of hollow cylinder piles shall be as shown on the Plans.

c. Prestressing. The Contractor shall submit shop drawings for the Engineer's approval in accordance with **Para. b of Subsection 809.02.1** of these Specifications. In addition, shop drawings shall show the pile dimensions, materials, prestressing methods, tendon arrangement and prestressing forces proposed for use, and, any addition or positioning of reinforcing steel

differing from that shown on the Plans. Manufacture of the piles shall not commence until the shop drawings have been approved by the Engineer.

d. Curing, Storage and Handling. Removal of forms, storage, transport, and handling of precast/prestressed concrete piles shall be done in such a manner as to prevent excessive bending stresses, cracking, spalling, or other injurious results. A curing plan shall be submitted to the Engineer as specified in **Subsection 809.03.8** of these Specifications. When lifted or moved, precast/prestressed concrete piles shall be supported at the quarter points or other designated pick-up points. Piles shall not be driven until the specified curing period is completed and the concrete has attained the specified 28-day compressive strength, or such longer period as may be specified in the Plans or Special Provisions.

e. Extensions. When required, extensions for precast/prestressed concrete piles shall be made by removing concrete at the end of the pile end to clear 40 diameters of reinforcement steel and to produce a face perpendicular to the axis of the pile. Reinforcement of the same size as that used in the pile shall be securely fastened to the projecting steel. Necessary formwork shall be placed to prevent leakage along the pile.

Immediately before placing concrete, the tops of piles shall be cleaned and wetted thoroughly and covered with a thin coating of approved suitable bonding material. Concrete of the same mix design and quality as that used in the pile shall be placed. Forms shall remain in place for not less than seven days. Extensions shall be cured and finished according to the applicable requirements of **SECTION 809.** Extended precast/prestressed piles shall not be driven.

804.03.4 Concrete-Filled Shell Piles.

a. General. Concrete-filled shell piles shall be constructed by driving metal shells, with or without a mandrel, placing reinforcement steel, and filling the driven shell with concrete. Shells shall be driven to the required tip elevation and capacities in accordance with these Specifications.

b. Shape and Minimum Dimensions. Concrete-filled shell piles may have a uniform cross section or may be tapered over any portion. Unless otherwise specified, the minimum diameter at the tip shall be 8 inches. Step-tapered or tapered piles shall step increase or taper at a rate of not less than one inch in 8 feet, as the Contractor may elect, until the nominal diameter is not less than 12 inches or more than 18 inches within which range the shaft may be extended with a substantially uniform diameter section. In any event, not less than 4 feet of the 12-inch butt section shall be provided below the cut-off. Uniform diameter shells shall have a minimum net effective diameter of not less than 11 inches. The minimum size of uniform piles shall be as shown on the Plans.

For 45-ton capacity reinforced concrete cast-in-place piles the following limitations shall apply. Step-tapered or tapered piles shall have a minimum net effective tip diameter of not less than 10 inches and shall step-increase or taper at a rate of not less than one inch in 8 feet as the Contractor may elect, until the nominal diameter is not less than 14 inches or more than 18 inches in which range the shaft may be extended with a substantially uniform diameter section. In any event, not less than 4 feet of the 14-inch butt section shall be provided below the cut-off. So-called uniform diameter shells shall have a minimum net effective diameter of not less than 11 inches for a length not to exceed 32 feet and thereafter the uniform diameter shaft shall have a

nominal diameter of not less than 14 inches. A minimum of 4 feet of the 14-inch butt section shall be provided below the cut-off.

c. Metal Shells. Metal shells shall meet the requirements of **Subsection M.07.08.1** of these Specifications, and shall be of sufficient thickness and strength to hold original form and show no harmful distortion after driving or driving of adjacent shells, or after withdrawal of the driving core. Shell designs other than that shown on the Plans shall be approved by the Engineer prior to use. The thickness of metal shells driven without a mandrel shall be a minimum of No. 9 gauge for fluted shells, and 3/16-inch for pipe shells. Shells driven with a mandrel shall have a thickness not less than No. 18 gauge.

d. Cleanout and Dewatering. Accumulated soil cuttings and water shall be evacuated from driven shell piles prior to placement of any concrete. The Contractor shall use those methods as needed to cleanout and dewater the shell, and which shall not result in damage to the shell. The Contractor shall provide equipment and facilities for containment, temporary storage, and separation of soil cuttings, and shall legally dispose of water accumulations.

e. Inspection of Driven Shells. Each driven shell pile shall be inspected and approved by the Engineer before any concrete is placed. The Contractor shall provide access to the pile and furnish a suitable illuminating device for inspection of the shell interior throughout its length. Any broken, improperly driven, or otherwise defective shell pile shall be removed and replaced as directed by the Engineer at no additional cost to the State.

f. Placement of Reinforcement and Concrete. Accumulated soils and water shall be removed from driven shells before concrete is placed. The class of concrete and arrangement of reinforcing shall be as shown and specified in the Plans. Reinforcing steel cages shall be fabricated, secured, and lowered down the shell pile in such a manner as to insure proper placement throughout the length of the pile, and to provide pile cap connections as shown in the Plans.

Concrete in steel-reinforced shell piles shall be placed and consolidated by vibration throughout the length of the pile interior, unless otherwise indicated on the Plans or directed by the Engineer.

No concrete shall be placed until all other shell pile driving within a radius of 20 feet of the driven pile has been completed. Alternatively, if approved by the Engineer or where allowed as specified in the Plans, all driving within the specified limits shall be discontinued until concrete in the last shell driven has set for at least five days.

804.03.5 Steel Pipe Piles.

a. General. Steel pipe piles shall be furnished and driven either as open-end or closed-piles as indicated on the Plans or otherwise authorized by the Engineer. When specified in the Contract Documents, steel pipe piles shall be concrete-filled throughout or across a portion of their length. Where practicable, steel piles shall be furnished full length.

b. Dimensions and Minimum Thicknesses. Steel pipe piles of outside diameter less than 14 inches shall have a minimum wall thickness of 1/4-inch. Piles of outside diameter 14 inches and larger shall have a minimum wall thickness of 3/8-inch.

c. Painting. When specified in the Plans or Special Provisions, before being driven or placed, steel pipe piles, closure plates, and splices shall be shop-painted with zinc-silicate primer. When specified, after piles are driven and all bracing members, concrete caps, and encasements are in place, all exposed steel shall be given one complete coat of field paint.

d. Drive Points, Drive Shoes and Closure Plates. When specified in the Plans or ordered by the Engineer, steel pipe piles shall be fitted with closure plates and/or drive points. Closed-end steel pipe piles shall generally be furnished with flat closure plates of the thickness and weight of steel as specified in the Plans. When specified, end closure plates shall be single-piece cast steel 60 degree conical points (ASTM A27), with an external flange unless otherwise permitted and as indicated in the Plans.

When specified, open-end or closed-end steel pipe piles shall be furnished with one-piece cast steel (ASTM A27) drive shoes, provided with a thickened ridge along the bearing surface between the pile tip and the shoe. Shoe flanges shall be external unless otherwise permitted in the Plans or Special Provisions, and shall be of the dimensions and weight of steel as indicated in the Plans.

Plates, drive points, and shoes shall provide full bearing with pile tips and shall be affixed to the piles using 5/16-inch continuous fillet welds along the flange or ridge contact with the pile tips.

e. Cleanout and Dewatering. Steel pipe piles driven open-ended shall be cleaned out to remove accumulated soil materials and dewatered. The Contractor shall use those methods as needed and appropriate to the soil materials encountered, and which shall not result in damage to the driven pipe pile, to remove soil cuttings from the interior of the pile.

The Contractor shall provide equipment and facilities for containment, temporary storage, and settlement and separation of soil cuttings and accumulated water. The Contractor shall legally dispose of water and accumulated soil cuttings.

f. Inspection of Driven Pipe Piles. The Contractor shall provide access and facilities for the Engineer to inspect the interior of each driven pipe pile. No driven steel pipe pile shall be accepted unless inspected and approved by the Engineer as described above in **Subsection 804.03.4, Para. e.**

g. Placement of Concrete and Steel Reinforcement. Where driven steel pipe piles shall be concrete-filled and no interior steel reinforcement is to be installed except within 5 feet of the cut-off elevation, concrete shall be placed in one continuous operation with flow directed down the center of the pile to consolidate by impact. Vibration or rodding shall be required only to a depth of 5 feet below the design cut-off elevation.

All steel pipe piles at each structure footing or within the radius indicated on the Plans shall be driven, cleaned out, and inspected prior to placement of concrete. Alternatively, if approved by the Engineer or, all driving within the specified limits shall be discontinued until concrete in the last pile driven has attained its 28-day compressive strength.

804.03.6 Steel H-Section Piles.

a. Dimensions and Section Thicknesses. Steel H-section piles shall be rolled structural steel shapes of the sections indicated on the Plans or otherwise authorized by the Engineer.

Where practicable, steel H-sections shall be furnished full length. H-section piles shall have a minimum web thickness of 0.400-inch.

b. Drive Points. When specified or authorized by the Engineer, H-section piles shall be fitted with drive points of the design specified. Drive points shall be cast in one piece steel conforming to ASTM A27 Grade 65-35. They shall have sufficient flange and continuous web vertical back-ups to provide proper alignment and secure fit with the pile. Flange surfaces to bear on rock or in soil may be horizontal or sloped (minimum 15 degrees to not more than 30 degrees) and may be provided with individual or continuous cutting teeth. The minimum weight of pile points shall be as specified in the Plans.

c. Painting. Where specified in the Plans, steel H-section piles shall be provided with a shop application of one coat of zinc-oxide primer. Additionally, exposed sections of piles as-driven shall receive one or more field-applied surface coats as specified. Lengths of pile to be concrete-encased shall not receive field coats unless otherwise specified.

d. Concrete Encasement. Where specified in the Plans or Special Provisions, exposed lengths of driven steel H-section piles shall be encased in concrete. The length, shape, and thickness of encasement and required reinforcement shall be as shown on the Plans. Concrete encasements shall be furnished and placed in accordance with the applicable requirements of **SECTIONS 601** and **808**, respectively, of these Specifications.

804.03.7 Composite Piles. Composite piles shall be furnished and fabricated of the materials and dimensions indicated on the Plans and described in the Special Provisions. Composite piles may consist two or more sections of different materials fabricated into a single pile which is then driven, or a driven section to which an upper section of different material is then added and then driven or will be exposed in the completed work. The installation of composite piles shall conform to the requirements of the Special Provisions.

804.03.8 Splices and Splicing Piles.

a. General. Where splicing is permitted, the splice shall develop the full strength of the unspliced pile. Splices shall be fabricated and installed as shown on the Plans. Any alternative method of splicing or commercial splice proposed for use shall provide equal results and shall have been approved by the Engineer prior to use.

b. Timber Piles. Unless otherwise provided for in the Special Provisions, timber piles shall not be spliced.

c. Steel Pipe, Shell, and H-Section Piles. Full length piles shall be used where practicable. Where splicing is required or authorized by the Engineer, the splice shall be as shown on the Plans. Splices shall be made by full penetration electric arc welding, or as approved by the Engineer. Proprietary or other fabricated steel splicers shall conform to ASTM A36, be approved by the Engineer before use and shall develop the full strength of the unspliced pile. The flanges of fabricated splicers shall be chamfered to enable effective welding.

Prior to splicing, the top of any pile that is bent, deformed, or twisted by driving shall be cut off or trued up normal with the axis of the pile before placing the next pile section. The end surfaces of piles shall provide full bearing with the next pile section or splicers. Axes of all spliced

sections shall be in the same straight alignment. All extensions, splices and build-ups shall conform to the design shown on the Plans.

The flanges of H-section piles shall be either spliced by butt welding or with plates that are welded or bolted. Prefabricated splicers may be used if the splice can develop the net section of the pile in compression, tension, shear and bending. Pipe piles shall be spliced either by butt welding or by the use of welded sleeves.

Surfaces to be welded shall be smooth, uniform, and free from loose scale, slag, grease, or other material which would prevent proper welding. Steel may be oxygen cut. Carbon-arc gouging, chipping, or grinding may be used for joint preparation.

Welding shall be permitted in all cases for splicing metal shells. Welding shall be used for splicing steel piles, attaching pile points, and attaching bracing or other steel members to steel piles when specified in the Plans. All welding and qualifications for welders shall conform to the applicable requirements of **Subsection 824.03.6; Welding**, of these Specifications.

d. Precast/Prestressed Concrete Piles. Precast/prestressed concrete piles shall not be spliced, other than to produce short extensions as permitted herein, unless specifically allowed by the Plans, the Special Provisions, or by written approval of the Engineer. Dowels or other mechanical splices shall be approved by the Engineer before incorporated into the work. Splices shall be designed to develop the full axial and moment capacity of the unspliced cross section.

804.03.9 Determination of Bearing Capacity.

a. General. Piles shall be driven to the bearing capacity shown on the Plans or specified in the Special Provisions. Pile bearing capacity shall be determined by the Engineer using one or a combination of the following methods.

1. Method A - Wave Equation Analysis. The ultimate bearing capacity of piles with design loads of less than or equal to 50 tons shall be determined by using a wave equation analysis prepared by a Rhode Island Registered Professional Engineer. Unless otherwise stated in the Special Provisions, the Contractor shall be responsible for performing the wave equation analysis. The results of the analysis, driving system specifications and data, and the proposed driving criteria shall be submitted by the Contractor to the Engineer for approval. Project test boring logs shall be provided in the Plans or otherwise made available to the Contractor for his use in preparing the analysis.

Unless otherwise specified, the Contractor shall perform a separate wave equation analysis for each design pile type, load and length shown in the Plans, and for each driving system the Contractor proposes for use. The analysis shall take into account the proposed hammer assembly, pile cap, blocks, and cushion characteristics, pile properties and estimated lengths, and anticipated soil properties. Pile driving equipment properties shall be as recommended or provided by the manufacturer of such materials and equipment. The design bearing capacity of a pile shall be 0.364 of the calculated ultimate bearing capacity as determined by a wave equation analysis alone. The analysis may, at the discretion of the Engineer, be used to establish design capacities of greater than 50 tons if similar piles have been installed in similar soil conditions in close proximity to the site.

2. Method B - Wave Equation Analysis Calibrated With Dynamic Pile Tests. When specified in the Contract, the Contractor shall perform a wave equation analysis and conduct dynamic load testing for each design pile type, load, and length, and proposed driving system. The Contractor shall retain or employ a Rhode Island Registered Professional Engineer to perform, supervise, and interpret the analysis and dynamic measurements. The results of the dynamic load test, the wave equation analysis results, and proposed ultimate pile capacity shall be submitted to the Engineer for approval.

Wave equation analyses calibrated with dynamic pile load test measurements may be used to determine the ultimate bearing capacity of piles with design loads of equal to or less than 50 tons.

At the discretion of the Engineer, this method may be used to establish design capacities of greater than 50 tons if similar piles have been installed in similar soil conditions in close proximity to the project site. The design bearing capacity of a pile shall be 0.444 of the ultimate bearing capacity determined from a wave equation which has been calibrated to the results of a dynamic pile load test.

The Contractor shall furnish and maintain in working order all force or stain transducers, acceleration-velocity-or-displacement transducers, transmission cables, and appropriate instrumentation for recording, reducing, and displaying the dynamic testing data. The Contractor shall furnish the electrical power required. Field generators shall be equipped with functioning meters for monitoring voltage and frequency. The Contractor shall also provide temporary shelter of adequate size to protect the dynamic test equipment from the elements.

(a) General Procedures for Wave Equation Analysis Calibrated with Dynamic Pile Tests.

(1) Pretest Pile Calibration. For timber and concrete piles, the Contractor shall initially determine strain wave speed for each pile to be dynamically tested during driving. Initial wave speed determination shall not be required for steel piles. The pile shall be supported horizontally above the ground, clear of other piling or obstructions, and its length measured and recorded. An accelerometer shall be securely attached to one end of the pile (bolted, glued, or welded). The Contractor shall provide and affix an impact cushion at the pile head as directed by the Engineer. A sledge hammer or other suitable weight shall be used to strike the end of the pile. The accelerometer signal shall be recorded and displayed, and the time between acceleration peaks measured for as many cycles as deemed necessary by the Engineer. The first impact should not be counted. The wave speed for the particular pile shall be calculated as the time divided by the corresponding travel length of the strain waves during the time interval.

(2) Prior to Driving. The Contractor shall furnish and attach transducers to the pile or provide access to the pile for the Engineer to attach instruments. Transducers shall be capable of independently measuring strain and acceleration verses time at a specific location along the pile axis during driving impact. A minimum of two, each, of strain and acceleration transducers shall be attached to the pile at the locations specified or directed by the Engineer. For mandrel driven piles, the mandrel may be instrumented similarly to a driven pile.

At any point along the length of the pile as specified or directed by the Engineer, a minimum of two, each, of strain and acceleration transducers shall be attached to the pile face or web as the case may be. Transducers shall be located at equal radial or cross-sectional distances on diametrically opposite sides of piles. They shall be located the same axial distance

from the bottom of the pile, and when near the upper end, they shall be attached at least 1½ pile diameters below the pile head. The Contractor shall align and protect the transmission cables to suit his method of operation but maintain the operation of the equipment during driving.

(3) Driving. The test pile shall be clearly marked at appropriate intervals throughout its length. The pile shall be positioned and aligned in the leads such that hammer impact is applied axially and concentrically with the pile. The Contractor shall drive the test pile to the depth at which the dynamic test equipment indicates that the design bearing capacity indicated on the Plans or specified in the Special Provisions has been achieved, unless otherwise directed by the Engineer. If upon further driving test piles "break through" after attaining the design bearing capacity, at the discretion of the Engineer, the Contractor shall further advance piles until the required bearing capacity is again indicated. The Contractor shall adjust the driving energy to maintain acceptable stresses in the pile, and shall realign the driving system if the testing equipment indicates that hammer impact is not delivered axially to the pile.

The Contractor shall monitor and record: ram travel length, bounce chamber pressure, and/or steam or air pressure at the inlet to the hammer as appropriate for the driving system used, and a record of blow counts for specific intervals of penetration during driving of test piles.

Dynamic force and velocity measurements for a specific penetration shall be taken for the impacts during the specified intervals to be monitored and for routine observations of penetration resistance as the Engineer may direct. Properties shall be determined from the specified minimum number of impact records during initial driving, and from representative blows at the beginning of any restriking. As specified or directed by the Engineer, the Contractor shall delay restriking a sufficient period of time after the end of initial driving to allow pore water pressure and soil strength changes to occur. The maximum amount of penetration or maximum total number of blows on restrike shall be as specified or directed by the Engineer. Pile capacity shall be determined from the results of the dynamic testing and wave equation analysis, and submitted to the Engineer for approval.

3. Method C - Static Pile Load Tests. When the design capacity of piles is greater than 50 tons, or as otherwise specified in the Contract, the driving criteria and ultimate load capacity shall be established for each pile type and capacity following procedures set forth in ASTM D1143, "Piles Under Static Axial Compressive Load," using the quick load compression test, except that the test shall be taken to plunging failure, or three times the design load, or 1,000 tons, whichever first occurs. Testing equipment and measuring systems shall conform to ASTM D1143 or as specified in the Special Provisions. Telltales and/or elastic strain gauges, appropriately sheathed, shall be installed in or along piles at the intervals specified, and vertical movements or incremental strain measurements shall be monitored. Dial gauges capable of reading increments of 0.001-inch shall be calibrated and used to monitor relative movements or strains at the pile tip, head, or specified interval along the pile length.

The Contractor shall submit for the Engineer's approval, a wave equation analysis for each type and capacity of pile to be tested, and, detailed plans of the proposed pile load test apparatus, including load frame and reference members, load cell or jacking apparatus, reaction system, and proposed method and intervals for telltale installation and protection. The wave equation analysis and pile load test plans shall be prepared by a Rhode Island Registered Professional Engineer, retained or employed by the Contractor. The load test apparatus shall be designed and

constructed to allow the various load increments to be placed gradually without causing vibration to the pile. The wave equation analyses shall demonstrate that piles will not be damaged during driving and shall determine the blow count necessary to achieve the required ultimate static capacities. The driving criteria proposed by the Contractor shall be subject to review and approval by the Engineer.

The design bearing capacity shall be defined as 50 percent of the failure load. The failure load of a pile under axial compressive load is that load which produces a settlement of the pile head at failure equal to:

$Sr = S + (0.15 + 0.008D)$, where

Sr = Settlement at failure, in inches;
D = Pile Diameter or Width, in inches;
S = Elastic Deformation of total unsupported pile length, in inches;

Piles to be utilized for load tests shall be manufactured or furnished with telltales and protective sleeves incorporated into or along the length of the pile as specified in the Plans or Special Provisions. The Contractor shall submit his proposed telltale design and method of installation to the Engineer for approval prior to manufacture or furnishing of piles. The telltales shall be suitably sleeved and protected during driving and shall be functional throughout the pile load test. Sleeves shall be properly secured and cast in the interior of precast or cast-in-place concrete piles, secured to the interior walls of steel pipe piles, or affixed to the faces of steel pipe, timber and precast piles or the web of H-section piles as shown on the Plans.

Telltales shall consist of solid, flush-joint sections of steel rods, which shall extend to and screw into threaded steel mounts affixed to or cast into the pile at the specified points along the pile length. Telltale sleeves shall be plastic or steel tubing as specified, and shall be properly aligned, installed and affixed to the screw mounts to the extent that tell tale rods can be lowered into the sleeves entirely under their own weight. Where permitted by the dimensions of the test pile, the Contractor may choose to protect the tubes by installing them inside steel or PVC pipe.

Sleeves and rods shall be furnished with end caps and otherwise suitably protected during driving of piles. Prior to installation of the telltale rods, sleeves shall be filled with a sufficient quantity of oil or grease to fully occupy the annular space between the sleeve and the rod. Telltale rods shall be installed into sleeves under the inspection of the Engineer. Any telltale rod installed without the Engineer's inspection shall be removed, measured, and re-inserted under the inspection of the Engineer.

The number and location of test piles shall be as shown in the Plans or specified in the Special Provisions, or as directed by the Engineer. Load test piles shall be driven to the minimum tip elevations and to the driving criteria determined based upon the wave equation analysis. The elevation of the top of the test pile shall be determined immediately after driving, after driving anchor piles, and just before load testing to determine heave. Any test pile which has heaved more than 1/4-inch shall be redriven or jacked to the original tip elevation prior to load testing. Unless otherwise specified in the Special Provisions, a minimum three-day waiting period shall be observed between the driving of any anchor piles or the load test pile, and the commencement of the pile load test.

The Contractor shall exercise care to prevent eccentric loading of the pile. If the test fails due to eccentric loading, no payment shall be made for the test and no future test shall be performed on the eccentrically loaded pile.

When the approved test method requires the use of tension (anchor) piles which will later be used as permanent piles in the work, such tension piles will be of the same type and diameter as the production piles and shall be driven in the location of the permanent piles.

The "Boot Strap" method shall be performed by jacking down on the test pile or piles with a calibrated hydraulic jack placed beneath a girder. The girder shall be anchored to tension piles located at least 6 feet from the test pile or piles. In no case shall piles closer than 6-feet from the test pile or piles be used to assist in anchoring the girder. Connections of the girder to the anchors and hydraulic jack shall be tight when the test is commenced and the jack shall be capable of moving the test pile or piles a vertical distance of at least 5 inches during the test.

If the load is applied to the test pile or piles by jacking against a dead load, such dead load shall not have supports closer than 6 feet from the test pile or piles. The jack shall be capable of moving the test pile or piles a vertical distance of 5 inches.

The Contractor shall have a qualified employee present at all times during the performance of the test to maintain the required load. If the test is stopped before completion and the load wholly or partially removed from the pile or piles due to defects in the jack, yield of connections, insufficient load or travel capacity of the jack, or for other mechanical reasons, the Engineer shall order the load test abandoned and replaced by a new test to be conducted on another pile or piles at an adjacent location. Where a loading test is abandoned because of reasons for which the Contractor is responsible, there shall be no payment for such an abandoned test.

804.03.10 Pile Driving Equipment.

a. General - Approval of Driving System. All pile driving equipment, including the hammer, hammer cushion, drive head, pile cushion, and other appurtenances to be furnished by the Contractor shall be approved in advance by the Engineer prior to beginning work. The Contractor shall submit a description of his proposed equipment a minimum of two weeks before starting work. Whenever the bearing capacity of piles is specified to be determined by a wave equation analysis, the Contractor shall submit calculations based upon the wave equation analysis (WEAP or other equivalent analysis) which shall demonstrate that the piles can be driven to the ordered length with a reasonable driving energy without damage to the piles. In the absence of other supporting data, the following hammer efficiencies shall be used in the analysis:

Hammer Type	Efficiency, Percent
Single-Acting, Air/Steam	67
Double-Acting, Air/Steam	50
Diesel	72

The Contractor's proposed driving equipment shall be evaluated based upon the required number of hammer blows per inch of pile penetration and the pile stresses at the required ultimate pile capacity. The required number of hammer blows indicated by the calculations for

the required bearing capacity shall be between 4 and 10 blows per inch in order for the equipment to be considered acceptable.

In addition, for the driving equipment to be considered acceptable, calculated pile stresses corresponding to the driving criteria and required pile capacity shall be less than the stress level that will result in damage to the pile. For steel piles compressive driving stresses shall not exceed 90 percent of the yield point (0.9 Fy) of the pile. For concrete piles, tensile stresses shall not exceed 3 times the square root of the concrete compressive strength, f'c, of the pile plus the effective prestress value, i.e., [3 x $(f'c)^{1/2}$ + prestress]. Compressive stresses in concrete piles shall not exceed 85 percent of the concrete compressive strength minus the effective prestress: (0.85 f'c - prestress). For timber piles, compressive stresses shall not exceed 3 times the allowable static design strength listed in the Plans.

During pile driving operations, the Contractor shall use the approved driving system. Any change in the driving system or equipment will be considered only after the Contractor has submitted revised pile driving equipment data and calculations for corresponding driving criteria and pile stresses.

The Engineer's approval of the pile driving equipment shall not relieve the Contractor of his responsibility to drive piles, free of damage, to the required bearing and tip elevations shown on the Plans or specified in the Special Provisions.

b. Hammers. Piles may be driven with drop hammers; single-, double- or differential-action compressed air or steam operated hammers, diesel hammers conforming to these Specifications. Vibratory or other pile driving methods may be used only when specifically authorized by the Engineer or allowed in the Special Provisions. Hammers shall be selected to suit the conditions to be encountered. If the selected hammer used is found to be unsatisfactory, it shall be replaced with a larger or smaller hammer of the same type or an alternate hammer type.

1. Gravity or Drop Hammers. Gravity or drop hammers may be used for driving timber piles, but shall not be used for precast concrete piles or for piles with design capacities greater than 30 tons. When gravity hammers are allowed, the ram weight shall be at least equivalent to the combined weight of the drive cap and the pile. In no case shall the ram weight be less than 3,000 pounds, and the fall height shall not exceed 12 feet. All drop hammers shall be equipped with hammer guides to insure concentric impact on the drive head or pile cushion.

In general energy developed by the hammer shall be at least one foot-pound for each pound of weight of the pile or casing being driven, but in no case shall it be less than 8,000 foot-pounds energy per blow.

2. Air- or Steam-Operated Hammers. The weight of the striking part of air- or steam-operated hammers shall not be less than 1/3 of the combined weight of the pile and drive cap, and in no case shall the striking part weigh less than 2,750 pounds.

Steam or air hammers to drive timber piles less than 50 feet in length shall develop not less than 8,000 foot-pounds of energy per blow; for timber piles 50 feet or greater in length, not less than 15,000 foot-pounds of energy per blow. Unless otherwise specified, hammers used for driving precast concrete piles, metal shells, steel H-section or pipe piles, shall develop not less than 15,000 foot-pounds of energy per blow.

The plant and equipment furnished shall have sufficient capacity to maintain, under working conditions, the pressure at the hammer as specified by the manufacturer. Boilers and compressors shall be equipped with accurate pressure gauges and a second gauge shall be applied at the hammer intake, unless other methods of determining hammer efficiency are authorized.

3. Diesel Hammers. Open-end (single-acting) diesel hammers shall be equipped with a device to permit the Engineer to determine hammer stroke at all times during pile driving operations. Closed-end (double-acting) diesel hammers shall be equipped with a bounce chamber pressure gauge, in good working order, mounted near ground level so that it can be easily read. A correlation chart of bounce chamber pressure and delivered hammer energy shall be provided by the Contractor.

4. Vibratory Pile Drivers. Vibratory pile drivers may be used, subject to the Engineer's approval, provided that sufficient correlated data is developed and furnished to permit a satisfactory evaluation of pile load-carrying capacity and performance. These characteristics shall be established by direct comparison with the penetration and performance of the same type(s) of pile, driven with conventional impact hammers under similar conditions and in corresponding locations.

A number of length determination piles as ordered by the Engineer shall be driven using a conventional hammer to determine with reasonable accuracy the depth of acceptable penetration throughout the area of each foundation or trestle bent. Subsequent piles to be driven using the accepted alternative method shall be driven to corresponding depths of penetration with minor adjustments if driving conditions change.

A representative number of such piles as designated by the Engineer shall be load tested to the required capacity, along with a corresponding number of those piles driven using the alternative method and equipment. Load test data shall be carefully recorded and correlated. A sufficient number of load tests shall be performed on piles driven using the alternative method as required to verify the results and insure design capacity.

No payments will be made to the Contractor for pile load tests in excess of those which would be required for piles driven by conventional methods, unless field conditions are such that the alternative methods must be used to advance piles. In such cases, such additional load tests will be measured for payment provided the Engineer has ordered the tests in writing, and the tests are carried to completion.

804.03.11 Driving Appurtenances.

a. Hammer Cushions. All impact driving equipment except gravity hammers shall be equipped with a suitable thickness of hammer cushion material to prevent damage to the pile or hammer and to insure uniform driving behavior. Hammer cushions shall be made of durable manufactured materials which will retain uniform properties during driving. Wood, wire rope, and asbestos hammer cushions shall not be permitted. A striker plate shall be placed on the hammer cushion to insure uniform compression of the cushion material. The hammer cushion will be inspected by the Engineer prior to beginning pile driving and after each 100 hours of pile driving. The Contractor shall replace the hammer cushion when there has occurred a thickness reduction of 25 percent of the original cushion thickness.

b. Pile Drive Head. Piles driven with impact hammers shall be fitted with an adequate drive head to distribute the hammer blow to the pile head. The drive head shall be axially aligned with the hammer and pile. The drive head shall be guided by leads and shall not be free swinging. The drive head shall fit around the pile in such a manner as to prevent transfer of torsional forces during driving while maintaining proper alignment of hammer and pile.

For steel and timber piles, the pile shall be cut off square and a drive head provided to hold the pile in line with the axis of the hammer. For precast and precast-prestressed concrete piles, the pile head shall be plane and perpendicular to the longitudinal axis of the pile to prevent eccentric impacts from the drive head. For special pile types, appropriate drive heads, mandrels, or other devices shall be provided so that piles can be driven without damage.

c. Pile Cushion. Concrete piles shall be protected by a pile cushion when the nature of driving is such as to unduly injure the piles. Where plywood is used, a minimum of 4 inches shall be placed on the pile head prior to driving. A new cushion shall be placed when the initial cushion is compressed to one-half its original thickness, or when the cushion begins to burn. The pile cushion dimensions shall be such that the hammer energy is uniformly distributed to the pile head.

d. Leads. Pile driving leads shall be used throughout the pile driving operation and shall support the pile and hammer in proper positions. Leads shall be constructed in a manner that affords freedom of movement of the hammer while maintaining alignment of the hammer and pile to insure concentric impact for each blow. The leads shall be of sufficient length to make the need for a follower unnecessary, and shall be designed to permit proper alignment of batter piles.

e. Followers. Followers shall only be used when specifically allowed in the Special Provisions or authorized in writing by the Engineer. When permitted, the first pile in every bent and the tenth pile driven thereafter shall be furnished sufficiently long and driven full length without a follower to verify that adequate pile penetration is being attained to develop the required capacity for those piles driven using a follower.

The follower and pile shall be held and maintained in equal and proper alignment during driving. The follower shall be of such material and dimensions to permit piles to be driven to the length determined to be necessary from the driving of the full length piles without a follower. The final position and alignment of the first two piles installed with followers in each substructure unit shall be verified to be in accordance with the location tolerances specified herein before additional piles are installed.

804.03.12 Preparation for Driving.

a. Preconstruction Survey and Vibration Monitoring. Unless otherwise specified in the Special Provisions, a preconstruction survey of any structure within 200 feet of pile driving shall be performed by a Rhode Island Registered Professional Engineer employed or retained by the Contractor and submitted to the Engineer prior to beginning work. The survey shall document the existing pre-construction condition of structures such that potential impacts due to pile driving can be assessed.

During pile driving the Contractor shall monitor vibrations at structures within 200 feet of pile driving using a seismograph capable of measuring vibration accelerations, velocities, and amplitudes in three mutually perpendicular directions. The vibration monitoring shall be

performed under the direction of a Rhode Island Registered Professional Engineer. The Contractor shall adjust his pile driving operations to limit construction vibration peak particle velocities to 1 inch per second, unless a lower limit is warranted based on the preconstruction survey. Daily summaries of peak particle velocities and vibration records shall be submitted to the Engineer on a weekly basis.

b. Layout and Elevation and Location Control. Unless otherwise specified in the Plans or Special Provisions, the Contractor shall be responsible for layout of all pile locations using offsets from the project baselines. The Contractor shall establish ground surface elevation at the proposed driving locations to the nearest 0.1-foot, referenced to the project elevation datum. The Contractor shall set tideboards as needed and as specified in the Plans or Special Provisions when driving piles on water. Mudline elevations shall be determined at each pile location on water prior to starting driving.

The Contractor shall verify the tip elevation of driven piles to the nearest 0.01-foot relative to the project elevation datum. Where foundation or trestle piles are driven in groups, or where piles are to be restruck, the Contractor shall check each pile tip elevation prior to and after restriking as required by the Engineer.

c. Excavations and Sheeting. In general, piles shall not be driven until after excavations are completed. Any material forced up between or around piles as a result of driving shall be removed to the correct elevation and that surface densified before any foundation concrete is placed.

Where sheeting or cofferdams are to be constructed, and piles will be driven within sheeting alignments, unless otherwise specified in the Special Provisions, the Contractor shall submit his proposed sequence of operations for the Engineer's approval prior to beginning any driving of sheeting or piles. The Contractor shall use those methods such that sheeting installation shall not interfere with, obstruct, damage or otherwise impact the function of bearing piles.

d. Preboring. When required by the Special Provisions or as shown in the Plans, the Contractor shall prebore holes at pile locations to the depths shown on the Plans, specified in the Special Provisions, or authorized by the Engineer. Prebored holes shall generally smaller in diameter than the diameter or diagonal of the cross section of the pile, except in the case where preboring is specified where driving vibrations are not permissible. Preboring shall be of sufficient depth to allow penetration of the pile to the specified depth. If subsurface obstructions are encountered, the hole diameter may be increased to the least dimension which is adequate for pile installation. Any void space remaining around the pile after completion of driving or other installation, shall be filled with sand or other approved material. The use of spuds to make a hole for inserting a pile shall not be permitted in lieu of preboring, unless specifically allowed in the Special Provisions or authorized in writing by the Engineer.

Piles to be driven through newly constructed embankments shall be driven in holes drilled or spudded through the embankment when the embankment is in excess of 5 feet in height. The hole shall have a diameter of not less than the greatest dimension of the pile cross section plus 6 inches. After driving the pile, the space around the pile shall be filled to the surface of the embankment with dry sand or fine gravel. Material resulting from drilling holes shall be disposed of as approved by the Engineer.

e. Templates and Support Spuds. The Contractor shall furnish and fabricate templates as he deems necessary to align and maintain piles at their proper location, alignment, or batter throughout driving. Such templates shall be securely fixed using such temporary spud piles or other appropriate bracing at the option of the Contractor. Template configurations and support piles shall be situated so as not to injure or displace driven piles nor interfere with pile driving or other portions of the work. The Contractor shall maintain templates in place after initial driving and until restriking has been completed. The Contractor shall dismantle and remove templates and temporary supports or piles so as not to damage, or misalign completed production piling. Templates and support piles shall remain the property of the Contractor, and no separate payment shall be made for furnishing materials or labor to construct templates or for support piles.

f. Measurement and Marking of Piles. The Contractor shall measure the total length of each pile to be driven, and shall clearly mark each pile in the increments and using the marking material specified in the Plans, the Special Provisions, or as directed by the Engineer. The Contractor shall notify the Engineer of the total measured length of each pile and shall allow the Engineer time to verify the length and to approve the pile marking prior to placing piles in the leads for driving.

During driving, the Contractor shall provide such markings on the leads or shall provide a graduated gauge which shall be clearly marked and situated at ground level to allow verification of the final driving resistance for each pile driven.

g. Jetting. Water jetting shall not be permitted unless specifically allowed in the Special Provisions, or authorized in writing by the Engineer. When water jetting is used, the Contractor shall determine the number of jets and volume and pressure at the jet nozzles, which are sufficient to freely erode material adjacent to the pile without affecting the lateral stability of the final in-place pile. The Contractor shall be responsible for restoring or repairing all damage to the site resulting from jetting. When jetting is specifically required in the Special Provisions, the plant shall have sufficient capacity to deliver at all times a pressure of 100 pounds per square inch at two, 3/4-inch jet nozzles. Whether specified or approved by the Engineer, jetting shall be ceased and the jets removed when the pile tip is at a minimum of 5 feet above the required tip elevation. The pile shall then be driven by impact hammer to the required tip elevation and bearing capacity. The Contractor shall control, treat as necessary, construct and maintain appropriate settlement basins, and legally dispose of sediments and expended jetting water as specified in the Special Provisions or as approved by the Engineer.

804.03.13 Driving Piles.

a. Pile Driving Records. The Contractor shall keep records for each pile driven of the number of blows required for each foot of penetration for the entire pile and penetration under the final series of blows (blows per inch for a minimum of the last 12 inches of driving). The records shall include the type and size of hammer used, rate of hammer operation, type and dimensions of driving helmet and cushion block. The records shall include the date, starting time, total driving time, pile location and identification number, pile type and size, ground elevation from which the pile is driven, and final elevation of the pile tip and butt. The records shall also indicate the quantity of concrete which may be placed in the pile.

b. General. Driving shall in general conform to the following procedure: in order to offset the progressive consolidation effect of pile grouping, where underground utilities are located in the immediate vicinity, the first pile driven shall be the one nearest the utility.

If, in the opinion of the Engineer, conditions during driving indicate that resistance is due to an obstruction, the Contractor shall employ adequate methods to drive the pile through the obstruction or he shall remove the obstruction. In the event that the Engineer agrees that the obstruction cannot be economically removed, the Contractor shall be allowed the option of driving an alternative pile (or piles) at a location designated by the Engineer. The initial pile shall be removed or cut off as directed by the Engineer. The Contractor shall be paid for the alternate pile or piles at Contract unit prices. However there shall be no payment for the initial pile or for any costs of attempting to remove the obstruction. The Contractor shall have no claim for delay if this contingency should arise and no claim for moving his equipment to and from the pile location.

c. Driving Test Piles. When specified in the Special Provisions, preliminary test piles and piles designated for dynamic or static load tests shall be driven at the locations and to the depths directed by the Engineer, before other production piles are ordered or driven in the area represented by the test. All test piles shall be driven with equipment identical to that which the Contractor proposes to use for production piles.

Test piles shall be driven to a hammer blow count established by the Engineer at the estimated tip elevation. Test piles which do not attain the specified hammer blow count at a depth of 1 foot above the estimated tip elevation shall be allowed to set up for a period determined by the Engineer before being redriven. If possible, the hammer shall be warmed up before redriving begins by applying at least 20 blows to another pile. If the specified hammer blow count is not attained upon redriving, the Engineer may direct the Contractor to drive a portion or all of the remaining pile length and repeat the set up and redrive procedure. When ordered by the Engineer, test piles driven to plan tip elevation without attaining the required hammer blow count, shall be spliced and driven until the required blow count is attained.

d. Utilization of Preliminary Test Piles and Loaded Test Piles. After the completion of loading tests, loaded test piles may be utilized in the permanent structure if found satisfactory for such use. Preliminary test piles driven to the required capacities may similarly be utilized in the permanent structure. Loaded test piles or preliminary piles determined not suitable for use in the permanent structure shall be removed, or cut off below ground and below base-of-footing or pile cap elevation, or disposed of in any other manner, all as directed by the Engineer.

e. Penetration of Piles. All piles shall be driven to a penetration such that the minimum pile tip elevation is attained, and such that the pile bearing value, determined as specified herein, is not less than that indicated on the Plans.

Piles located offshore, alongshore, in stream beds or along stream banks shall be driven to such penetration as the Engineer deems necessary for protection from scour.

If, after a test pile or production pile is driven through and below a hard stratum, the bearing value of the pile drops below the capacity required on the Plans, the Engineer may require the Contractor to drive permanent piles through the hard stratum to a penetration at which the required capacity is again attained.

When production friction piles fail to achieve design bearing capacities after driving the full finished lengths, these piles, when approved by the Engineer, can be left for a minimum of 24 hours to allow soil setup before attempting to splice. After the waiting period has passed, the Contractor shall redrive one representative pile in each pile group to check the gain in bearing

upon soil setup. The soil setup bearing shall be based upon the number of redriving blows necessary to drive the pile an additional 3 inches. These piles may be accepted without splicing if they exhibit the required bearing capacities upon redriving.

f. Driven Pile Location and Alignment Tolerances. All piles shall be driven at the locations and alignments shown on the Plans unless otherwise authorized by the Engineer. Piles shall be driven to within an axial tolerance not to exceed 1/4-inch per foot variation from the vertical or from the design batter orientation. Piles for trestle bents shall be driven such that the bent cap may be constructed in its design location without inducing excessive stresses in the piles. The final position of the axial center of driven foundation piles, measured in the plane of the cut-off elevation, shall not deviate from the design location by more than 6 inches or 1/4 of their diameter, whichever is greater, provided that:

1. The average deviation along a line of piles in any direction within the bent shall not exceed 3 inches from the line through the pile center locations shown on the Plans; and,

2. The nearest edge of any pile shall not be closer than 9 inches from the design position of the edge of footing or pile bent cap; and,

3. The minimum distance between the centers of any two adjacent piles is not less than 24 inches at the cut-off elevation.

4. The center of gravity of the pile group at any trestle bent or foundation as calculated at the cut-off elevation, shall not exceed the tolerances specified in the Plans or Special Provisions for that pile group.

If the location of any pile exceeds these tolerances, then it shall be the Contractor's responsibility to provide appropriate calculations to show the center of gravity of the pile group at the cut-off elevation as driven. Should the center of gravity of any pile group exceed the limits specified, or otherwise presented in the Plans or Special Provisions, it shall be the Contractor's responsibility to submit a detailed remedy, including all relevant engineering calculations, for review and approval by the Engineer. The Contractor shall further be responsible for performing the approved corrective action, including replacement of misaligned piles and/or furnishing materials and constructing any required increase in footing dimensions, at no additional cost to the State.

Manipulation of piles after driving in order to force them into proper position will not be permitted; the Contractor shall remove, or if space allows and as allowed by the Engineer, cut off misdriven piles, and then redrive or replace mislocated piles to the satisfaction of the Engineer.

g. Pile Heave and Restriking. The top elevation of each pile head shall be determined immediately after driving and again after completion of the driving of all piles within any foundation or trestle pile group. Any pile which heaves more than 1/4-inch, or otherwise specified in the Special Provisions shall be redriven to the design tip elevation and to the required driving resistance.

For concrete-filled piles, the Contractor shall restrike heaved shells or steel pipe piles prior to placing concrete in any pile within that pile group which has not evidenced heave.

804.03.14 Defective, Damaged or Broken Piles. The Contractor's driving operations and procedures shall not subject piles to excessive or undue injury or stresses producing spalling and crushing of concrete; splitting, splintering or brooming of timber piles; or splitting or excessive deformation of steel piles and shells. Any pile damaged by reason of internal defects, improper driving, driven out of position or driven below the butt elevation indicated on the Plans or as authorized by the Engineer, shall be corrected by the Contractor by one of the following methods as approved by the Engineer:

a. The pile shall be withdrawn and replaced by a new, and if necessary, longer pile;

b. The defective or low pile shall be cut off below base-of-footing elevation, and a second pile shall be driven adjacent to the defective or low pile.

c. The pile shall be spliced or otherwise built-up as provided for herein, or, the footing shall be sufficiently extended and reinforced to properly embed the pile.

Any and all such remedial materials and work shall be provided and performed by the Contractor at no additional expense to the State.

804.03.15 Pile Dewatering, Cleanout, and Spoil/Water Containment and Disposal. The Contractor shall remove soil materials, debris and/or accumulated water from driven steel pipe piles and metal shell piles to the satisfaction of the Engineer to allow inspection of pile interiors and prior to placement of any concrete. The Contractor shall provide for the control, containment, separation of sediments, and legal disposal of sediments and water volumes removed from such piles. The Contractor shall further be responsible to restore or repair any damage to the site incurred by dewatering and cleanout of piles. This work shall be considered included and integral to the installation of these pile types. No separate measurement or payment shall be made for this work.

804.03.16 Pile Cut-offs. Piles shall not be cut off until all piles within a pile group or within the area specified have been checked for heave and any required restriking or redriving has been completed.

Unless otherwise specified, all piles shall be cut off perpendicular to the longitudinal axis of the pile at the elevations specified in the Plans. Piles which support timber caps or grillages shall be sawed or otherwise cut off to conform to the plane of the bottom of the superimposed structure. In all cases, the amount of cut-off length shall be sufficient to remove any portion of the pile top which has been trimmed for driving, bruised, or otherwise deformed or damaged during driving. Cut-off piles shall be anchored to the structure, or otherwise protected as specified until incorporated into the remainder of the work.

The cut-off portions of all piles including test piles shall be retained and made available for use in splicing or building up piles as required until the pile driving is complete. Upon completion of the work, piling cut-off lengths shall become the property of the Contractor and shall be legally disposed of off-site at the Contractor's expense.

Cut-off pile heads, cuts for bracing, and exposed abrasions of treated timber piles shall be trimmed and then given field coatings of preservatives as specified in the Special Provisions. Predrilled bolt holes shall be impregnated with the approved field preservative. If treated holes will remain open, field-treated wood plugs or other temporary plugs approved by the Engineer shall be installed in the holes.

Where specified, after trimming and applying the approved field preservative, a sheet of three-ply roofing felt, or a sheet of galvanized iron, not lighter than 24 gauge, and of sufficient area to project at least 6 inches outside and completely around the pile head, shall be bent down over the top of the pile to fit tightly around the pile. The edges of this cover shall trimmed and fastened securely to the pile face with large-headed galvanized roofing nails or by being bound with galvanized wire.

The tops and faces of precast concrete piles which are to be embedded in the structure shall be cleaned and minor chipping or spalling removed.

Steel pipe piles and metal shells shall be cut off at the design elevation prior to emplacement of concrete fills. If steel pipe or shell piles are to remain unfilled, the Contractor shall provide and install protective caps as specified in the Plans or Special Provisions.

804.04 METHOD OF MEASUREMENT.

804.04.1 Piles Furnished and Driven. "Timber Piles" (treated or untreated); "Precast/Pre-stressed Concrete Piles" (solid rectangular, cylindrical, or hollow cylindrical); "Steel Piles" (H-piles, or pipe piles, or steel shell piles); or "Composite Piles," to be furnished and driven, shall be measured to the nearest linear foot of pile, calculated from the tip elevation to the specified cut-off elevation, in accordance with the Plans and/or as directed by the Engineer.

804.04.2 Piles Furnished. "Precast/Prestressed Concrete Piles" (solid rectangular, cylindrical, or hollow cylindrical), to be furnished, shall be measured to the nearest linear foot of pile, delivered to or manufactured at the site of the work, and inspected and accepted in accordance with the Plans and/or as directed by the Engineer.

a. Preliminary Test Piles. Measurement for payment for preliminary test piles shall be made for that length authorized by the Engineer in writing prior to delivery of piles.

That additional footage of production or preliminary piles furnished by the Contractor at his option shall not be included in the quantity measured for payment. Piles furnished by the Contractor to replace piles which were previously accepted by the Engineer, but subsequently damaged prior to completion of the Contract shall not be measured for payment.

804.04.3 Piles Driven. "Precast/Prestressed Concrete Piles" (solid rectangular, cylindrical, or hollow cylindrical), to be driven, shall be measured to the nearest linear foot, calculated from the tip elevation to the cut-off elevation, of pile permanently remaining in place, and inspected and accepted in accordance with the Plans and/or as directed by the Engineer.

804.04.4 Pile Cut-offs. "Pile Cut-offs" shall be measured by the number of pile cut-offs actually performed by the Contractor in accordance with the Plans and/or as directed by the Engineer.

804.04.5 Pile Load Tests. "Pile Load Tests" shall be measured by the number of pile load tests actually performed by the Contractor in accordance with the Plans and or as directed by the Engineer. Anchor or tension piles installed solely at the option of the Contractor for his use in conducting pile load tests shall not be measured separately for payment.

804.04.6 Metal Boots, Drive Points, Drive Shoes and Closure Plates. "Metal Boots," "Drive Points," "Drive Shoes," and "Closure Plates," when called for, shall be measured by the number of the respective items actually installed by the Contractor in accordance with the Plans and/or as directed by the Engineer.

804.04.7 Preboring. "Preboring," when called for, shall be measured by the number of prebored holes actually installed by the Contractor in accordance with the Plans and/or as directed by the Engineer.

804.04.8 Painting. "Painting," when called for, shall be measured by the linear foot of pile actually painted in accordance with the Plans and/or as directed by the Engineer.

804.04.9 Mobilization and Demobilization of Pile Driving Equipment. This item does not require measurement for payment.

804.04.10 Related Items. Steel reinforcement for steel shell piles or steel pipe piles shall be measured for payment under the provisions of **SECTION 810; REINFORCING STEEL**, of these Specifications. Concrete for steel shell piles or steel pipe piles shall be measured for payment under the applicable provisions of **SECTION 601; PORTLAND CEMENT CONCRETE** and **SECTION 808; CAST-IN-PLACE STRUCTURE CONCRETE MASONRY**, of these Specifications. Excavations for foundations dug prior to installation piles shall be measured for payment under the applicable provisions of **SECTION 203; STRUCTURE EXCAVATION AND BACKFILL**, of these Specifications. Sheeting driven prior to installation of piles shall be measured for payment under the applicable provisions of **SECTION 805; EARTH RETAINING SYSTEMS**, of these Specifications. Test piles driven prior to the installation of production piles and used for the purpose of pile load tests shall be measured for payment under the appropriate Paragraph of this Section.

804.04.11 Incidental Items. The following items of work shall not be measured separately for payment, but shall be considered incidental to the other items of work inherent to this Section: Wave Equation Analysis; Pre-Construction Survey and Monitoring; Layout, Elevation and Location Control; Templates and Support Spuds; Measurement and Marking; Pile Splices; Concrete Encasement for H-Piles; Cleanout and Dewatering of Shell Piles and Pipe Piles; Collars, Bands, Strapping and Trimming for Timber Piles; Extensions of Precast/Prestressed Concrete Piles; Hammer Cushions; Drive Heads; Pile Cushions; Leads; Followers; and Jetting.

804.05 BASIS OF PAYMENT.

804.05.1 Piles Furnished and Driven, Piles Furnished, and Piles Driven. The accepted quantities of "Piles Furnished and Driven," "Piles Furnished," and "Piles Driven" for the specific size and type of piles specified shall be paid for at their respective contract unit prices per linear foot as listed in the Proposal. The prices so-stated shall constitute full and complete compensation for all labor, materials, tools, equipment and all other incidental items of work necessary to finish the work, complete and accepted by the Engineer.

804.05.2 Pile Cut-offs. The accepted quantity of "Pile Cut-offs" will be paid for at the contract unit price per each such cut-off as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, and equipment, and all other incidentals required to finish the work, complete and accepted by the Engineer.

804.05.3 Pile Load Tests. The accepted number of "Static Pile Load Tests," or "Dynamic Load Tests," will be paid for at their respective contract unit prices per each such test as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, materials, and equipment, including instrumentation and all other incidentals required to finish the work, complete and accepted by the Engineer.

804.05.4 Metal Boots, Drive Points, Drive Shoes, and Closure Plates. The accepted quantities of "Metal Boots," "Drive Points," "Drive Shoes," and "Closure Plates" will be paid for at their respective contract unit prices per each such item as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, materials, equipment, and all other incidentals required to finish the work, complete and accepted by the Engineer.

When these items are not specified in the Contract Documents, but ordered by the Engineer, they will be paid for under the provisions of **Subsection 104.05; Extra Work**, of these Specifications. No payment shall be made for splicers or splicing made at the Contractor's initiative.

804.05.5 Preboring. The accepted quantity of "Preboring" will be paid for at the contract unit price per each such hole actually installed as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials and equipment, and all other incidentals required to finish the work, complete and accepted by the Engineer.

804.05.6 Painting. The accepted quantity of "Painting" will be paid for at the contract unit price per linear foot of pile as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials and equipment, and all other incidentals required to finish the work, complete and accepted by the Engineer.

804.05.7 Mobilization and Demobilization of Pile Driving Equipment. When "Mobilization and Demobilization of Pile Driving Equipment" is specified for separate payment in the Contract, such payment will be made at the contract lump sum price as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, and equipment necessary for the handling and driving of piles and for the removing of same on completion of the work.

a. Partial Payment. One half (50 percent) of the lump sum price may be made when equipment has been set up at the site and when the wave equation analysis, and preconstruction survey have been completed, submitted and approved by the Engineer. The remaining 50 percent of the lump sum price may be made when the driving and vibration records have been submitted and approved, and the equipment removed from the site, all to the complete satisfaction of the Engineer.

SECTION 805

EARTH RETAINING SYSTEMS

805.01 DESCRIPTION. This work consists of the provision of temporary and/or permanent sheet piling, temporary and/or permanent sheet piling with ground anchors; and soldier piles and lagging, at the locations indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

Sheet piling shall be untreated timber, treated timber, or rolled steel sections.

For sheet piling in cofferdams, refer to **Subsection 203.03.2** of these Specifications.

Soldier piles shall be steel HP sections or treated or untreated timber piles, and shall be driven or installed in pre-drilled shaft excavations. Lagging shall consist of timber or steel sections which shall span adjacent soldier piles.

805.01.1 Permanent Sheet Piling. Permanent sheet piling and supports shall be furnished, installed, cut-off and left in place as part of the finished structure. The Plans may require the removal of waling and other bracing members. Sheet piling will be of the section, dimension and length as indicated on the Plans.

805.01.2 Temporary Sheet Piling and Temporary Sheet Piling Abandoned in Place.

a. Temporary Sheet Piling shall be installed, maintained, and removed from the job site either after its function has been accomplished or when ordered to do so by the Engineer. Unless otherwise specified, the section, dimension and lengths of sheet piling shall be as determined by the Engineer.

The Contractor's attention is directed to the required construction sequence and the temporary sheet piling necessary to accomplish the work in accordance with the Plans and Specifications.

b. Temporary Sheet Piling Abandoned in Place is defined as sheeting used during construction but which is not a necessary structural component of the completed highway facility or bridge structure. Temporary Sheet Piling Abandoned in Place and supports shall be furnished, installed, cut off and left in place as shown on the Plans. The Plans may require the removal of waling and other bracing members. Temporary Sheet Piling Abandoned in Place shall be of the section, dimensions and lengths as specified on the Plans.

805.01.3 Soldier Pile-and-Lagging. Soldier piles-and-lagging shall be furnished, installed, cut off and left in place unless otherwise indicated. The Plans or Special Provisions may require removal or cut-off of piles, and removal of lagging and supports. Soldier pile-and-lagging will be installed to the elevation and be of the section and dimension indicated on the Plans.

805.01.4 Design and Approval of Sheet Piling and Soldier Pile-and-Lagging. Unless otherwise noted on the Plans or Special Provision, sheet piling and soldier piles and lagging shall be installed in accordance with the design and details provided on the Plans. Should the Contractor wish to deviate from the design provided, he shall then submit complete design drawings, computations and layout drawings for the temporary or permanent sheeting. All drawings and computations shall be prepared and stamped by a Rhode Island Registered Professional Engineer. The shop drawing submittal shall conform to the requirements of **Subsection 105.02; Plans and Shop Drawings**. Sheet piling or soldier pile-and-lagging located adjacent to railroad property shall also be submitted to the railroad company for their review and approval. (See the General Provisions/Construction section of the Project Specifications for specific requirements regarding the installation of sheeting adjacent to railroad properties.)

805.01.5 Utilities. The Contractor's attention is specifically directed to the proximity of utilities in the area of the proposed sheeting or pile installation work. In regard thereto, it shall be the Contractor's responsibility to give notice to each public utility whose facilities could be affected

by the work forty-eight hours in advance and request that a representative of the utility be present at all times during the work. If a utility refuses and/or fails to send a representative to the work site, when and as requested by the Contractor, the Contractor shall notify the Engineer of such refusal. The Engineer shall then notify the Public Utilities Administrator of the Division of Public Utilities and Carriers of the State of Rhode Island of such refusal and/or failure to appear and request said Administration to order such utility to send a representative to the work site. The Contractor and the Engineer shall maintain detailed records of all such communication regarding the above.

805.02 MATERIALS.

805.02.1 Untreated Timber Sheet Piling shall conform to the requirements of **Subsection M.07.01** of these Specifications.

805.02.2 Treated Timber Sheet Piling shall conform to the requirements of **Subsection M.07.02** of these Specifications.

805.02.3 Steel Sheet Piling shall conform to the requirements of **Subsection M.07.04** of these Specifications.

805.02.4 Steel Soldier Piles shall conform to the requirements of **Subsection M.07.09.**

805.02.5 Untreated Timber Soldier Piles shall conform to the requirements of **Subsection M.07.05**.

805.02.6 Treated Timber Soldier Piles shall conform to the requirements of **Subsection M.07.06**.

805.02.7 Timber Lagging, Walers, and Bracing shall conform to the requirements of **Subsection M.11.01.**

805.02.8 Steel Lagging, Walers, and Bracing shall conform to the requirements of **Subsection M.05.04.**

805.02.9 Hardware - Fixtures, Bolts, and Lag Screws shall conform to the applicable requirements of either **Subsection M.05.04.4** or **Subsection M.05.04.13** of these Specifications except as modified by Plans and Special Provisions.

805.02.10 Metal Casings for stabilization of drilled shaft excavations shall conform to the requirements of **Subsection M.07.08.1.**

805.02.11 Concrete Backfill for drilled shaft excavations shall be excavatable or lean concrete which conforms to the requirements of **SECTION 603; CONTROLLED LOW STRENGTH MATERIAL**, of these Specifications.

805.02.12 Anchors.

a. **Anchor Material** shall consist of either single or multiple elements of the following:

1. Uncoated seven wire stress relieved strand conforming to the requirements of ASTM A416.

2. Uncoated high-strength steel bars conforming to the requirements of ASTM A722.

b. Bearing Plates, Brackets, Stiffeners, and/or Rolled Steel Shapes shall conform to the requirements of ASTM A709, Grade 36.

c. Sheathing of the unbonded length of a tendon shall consist of one of the following:

1. Seamless polyethylene tube with a minimum wall thickness of 50 mils.

2. Seamless polypropylene tube with a minimum wall thickness of 50 mils.

3. Corrugated polyvinyl chloride tube with a minimum wall thickness of 30 mils.

d. Anchor Grout. The grout to be used for anchorage shall consist of a pumpable mixture of Types I, II, or III Portland cement, sand, water, and admixtures. Chemical additives which can control bleed or retard set may be used with the anchor grout. Additives, if used, shall be in accordance with the manufacturer's recommendations. Expansive additives and accelerators will not be allowed. Portland cement shall conform to the requirements of AASHTO M85. Cement used for grouting shall not contain any lumps or other indications of hydration or "pack set." Water for mixing grout shall be potable, clean, and free from injurious quantities of substances known to be harmful to Portland cement or the anchor steel. The grout shall be capable of reaching a cube compressive strength of 3,500 psi in seven days when tested in accordance with ASTM T106.

e. Grease shall conform to the requirements of ASTM D4950.

f. Centralizers shall be fabricated from plastic, steel, or material which is not detrimental to the anchor tendon. Wood will not be allowed. The centralizer shall be able to maintain the position of the tendon so that a minimum of 0.5-inch of grout cover is obtained on the tendons.

g. Spacers for separation of elements of a multi-element tendon shall permit the free flow of grout and shall be fabricated from plastic, steel, or material which is not detrimental to the anchor tendon. Wood will not be allowed.

805.03 CONSTRUCTION METHODS. The Contractor shall furnish and install sheet piling or soldier pile-and-lagging as shown on the Plans or as indicated in the Special Provisions.

805.03.1 General. The Engineer may order additional or stronger bracing and supports at any point where, in his opinion, sufficient and proper bracing and supports have not been provided.

The Engineer may order additional temporary sheet piling to be installed when, in his opinion, field conditions make it necessary to properly protect the work under construction or any existing installation affected by the construction.

The estimated amount of sheet piling and soldier piles-and-lagging for the Contract, as shown on the Plans or indicated in the Proposal, is the only amount for which the State will make

direct reimbursement to the Contractor unless additional sheeting or soldier piles-and-lagging is ordered in writing by the Engineer. Additional temporary sheet piling may also be ordered by the Engineer when indicated by field conditions as specified above.

Additional compensation shall be provided for such additional or modified temporary or permanent sheet piling or soldier piles-and-lagging which has been directed and/or approved by the Engineer.

805.03.2 Driving Sheet Piling and Soldier Piles. When required by the Plans or Special Provisions, the preconstruction survey of adjacent structures shall be performed and the findings submitted to the Engineer for his review. No driving shall commence until the Engineer has approved the preconstruction survey. If required in the Plans or Special Provisions, the Contractor shall perform vibration monitoring during driving of sheeting or piles. The preconstruction survey and vibration monitoring work shall conform to the requirements described in **Subsection 804.03.12; Para. a,** of these Specifications.

Sheet piling and soldier piles shall be driven reasonably true to the line and depth as indicated on the Plans or as directed by the Engineer. Steam, pneumatic or diesel powered vibratory hammers of appropriate capacity shall be used to drive all sheet piling and soldier piles. Any material which interrupts the driving shall be removed by the Contractor.

Soldier piles shall be driven to the location and axial tolerances specified in **Para. f** of **Subsection 804.03.13** of these Specifications, or as otherwise indicated on the Plans.

805.03.3 Pre-drilled Soldier Pile Installation. Soldier piles shall be installed in pre-drilled or pre-augered holes when required by the Plans or Special Provisions, or: 1) when vibratory or impact driving is not permitted; or 2) when obstructions prevent driving and the Engineer authorizes pre-drilling or pre-augering. In the case of 2) above, standard driving shall be resumed when the obstruction has been removed or bypassed.

Pre-drilled or pre-augered holes shall be of the diameter shown on the Plans and shall be of sufficiently large diameter such that concrete, lean concrete, or other backfill approved by the Engineer can be installed in the annulus between the soldier pile and the sidewalls of the drilled hole.

Drilled or augered holes shall be advanced to the required depth as indicated on the Plans or to the depth approved by the Engineer. It shall be the Contractor's responsibility to use those methods and equipment to maintain the sidewalls of the excavated shaft, and to completely clean out and remove soil materials, cuttings, and water from the shaft excavation prior to the installation of soldier piles and concrete backfill. Such efforts and equipment shall be considered as part of the work and shall not be considered for additional compensation.

Soldier piles shall be placed into the shaft such that they do not sustain damage, and shall be vertically centered and aligned such that their final position when backfilled, meets the specified location and axial tolerances. Damaged or out-of-tolerance soldier piles which must be removed and reinstalled or replaced shall not be measured for payment.

Concrete, lean concrete, or other approved backfill shall be placed in the shaft to completely encase the soldier pile. Concrete shall be placed from the bottom of the drilled shaft up to the specified elevation or ground surface. The shaft shall be dewatered before placing

concrete backfill. If during pumping excessive water inflow is encountered, the Engineer may require alternative methods to reduce inflow, alter the concrete mix, or approve alternative backfill materials.

Concrete backfill shall cure for a minimum of 5 days before excavation and lagging installation begins. Equipment or other construction operations which might disturb the concrete shall not be allowed in the vicinity of the installed pile until the concrete has cured.

805.03.4 Earthwork and Installation of Lagging. Excavation shall conform to the requirements of **Subsections 202.03 or 203.03** of these Specifications. Placement and securing of lagging shall closely follow excavation in front of pile-and-lagging such that loss of ground is minimized. Lagging shall be installed horizontally between soldier piles. Excavation shall proceed only as required to set one row of lagging. When one row of lagging has been placed, excavation for the next lower row may commence.

805.03.5 Openings and Cut-offs. The Contractor shall prepare and cut openings within the sheet piling or piles-and-lagging to permit the passage of all necessary utilities. Cost of preparation of openings for passing of utilities shall be included in the applicable unit bid price for sheet piling or soldier pile-and-lagging.

Sheet piling, whether temporary or permanent, shall be cut off as necessary during construction to allow work to proceed. Permanent sheet piling shall be cut off in a straight line at the elevations indicated on the Plans.

Soldier piles shall be cut off cleanly and horizontally at the elevations indicated on the Plans. Concrete backfill, lagging, and other supports shall be removed to the elevations indicated on the Plans or as directed by the Engineer.

805.03.6 Installation of Ground Anchors. The Contractor shall select the drilling method, the grouting procedure, and the grouting pressure to be used for the installation of the ground anchor as necessary to satisfy the load test requirements. The method of drilling used shall prevent loss of ground above the drilled hole that may be detrimental to the structure or existing structures. If water is used in the drilling operation, the Contractor shall be responsible for controlling and disposing of the water in such a manner that is not harmful to the site, environment, and adjacent property. Any damage caused by loss of ground or inadequate control of water shall be repaired immediately by the Contractor at no cost to the State.

The hole diameter in free length shall not be less than 3 inches nor greater than 12 inches. The hole shall remain open until grouting begins. Casing may be necessary to maintain a clean open hole. Casing, if used, shall be removed as grouting progresses unless permitted by the Engineer to be left in place. The tendon shall be inserted into the drilled hole without difficulty. When the tendon cannot be completely inserted, it shall be removed and the drill hole cleaned or re-drilled to permit insertion of the tendon without difficulty. Partially inserted tendons shall not be driven or forced into the hole.

The location, inclination, and alignment of the drilled hole shall be as shown on the Plans. Inclination and alignment shall be within plus-or-minus 3 degrees of the planned angle at the bearing plate and within plus-or-minus 12 inches of the planned location at the ground surface (point of entry).

The Engineer shall be responsible for determining the anchor bond length necessary to develop adequate load capacity to satisfy anchor testing acceptance criteria for the design load shown on the Plans. However, the drilled anchor hole shall not extend outside of the right-of-way limits shown on the Plans. The minimum bond length shall be 10 feet in competent rock, 15 feet in soil, or the minimum shown on the Plans. The anchor hole shall extend a minimum of 1 foot beyond the tendon length to be installed by the Contractor.

The grouting equipment shall produce a grout free of lumps and undispersed cement. A positive displacement grout pump shall be equipped with a gauge to monitor and record grout pressures. The pressure gauge shall be capable of measuring pressures of at least 150 psi or twice the actual grout pressures anticipated, whichever is greater. The grouting equipment shall be sized to enable the grout to be pumped in one continuous operation. The mixer shall be capable of continuously agitating the grout.

The grout shall be injected at the lowest point of the drill hole. The hole shall be filled with grout progressively from the bottom to the top to prevent air voids. The grout may be pumped through grout tubes, casings, hollow-stem augers, or drill rods. The grout shall be placed after the insertion of the tendon into the drill hole. The quantity of grout and the grout pressures shall be recorded by the Contractor. The grout pressures and quantities shall be controlled to prevent heave of the ground or fracturing of rock formations.

Except where modified below, the grout above the top of the bond length may be placed at the same time as the bond length grout, but it shall not be placed under pressure. The grout at the top of the hole shall stop a minimum of 6 inches from the back of the structure or trumpet, whichever is lowest. If the ground anchor is installed in fine grained soil using a drilled hole larger than 6 inches in diameter, then the grout above the top of the bond length shall be placed after the ground anchor has been successfully load tested. If the grout is placed in two stages, the initial stage must completely fill the hole to a point 2 feet above the bond length portion of the ground anchor. The entire drill hole may be grouted at the same time if the Contractor can demonstrate that the ground anchor system does not derive a significant portion (less than 5 percent) of its load resistance from the soil above the bond length portion of the ground anchor. Upon completion of grouting, the grout tube may remain in the drill hole provided it is filled with grout. Also, after grouting, the tendon shall not be loaded for seven days, unless otherwise approved by the Engineer.

Tendons shall be free of dirt, detrimental rust (see below), or other deleterious substances. Prior to installation, tendons shall be handled and stored in such a manner as to avoid corrosion and physical damage. Damage such as abrasions, cuts, nicks, welds, weld splatters, or heavy corrosion and pitting will be cause for rejection of the element. A slight rusting, provided it is not sufficient to cause pits visible to the unaided eye, shall not be cause for rejection. Rejected elements shall be replaced at no additional cost to the State in terms of either material replacement and/or resulting time delays. Grounding of welding leads to the tendon is not permitted. The bond length of the tendon shall be degreased prior to installation in the hole. No solvent residue shall remain on the tendon.

Each ground anchor shall be load tested by the Contractor. No load greater than 10 percent of the design load may be applied to the ground anchor prior to load testing. The stressing equipment shall be placed over the ground anchor in such a manner that the jack, bearing plates, load cell, and stressing anchorage are axially aligned with the tendon and the tendon is centered within the equipment. The test shall be simultaneously applied to the entire

tendon. During all testing, the movement of the tendon shall be recorded at each load increment to the nearest 0.001-inch with a dial gauge or vernier scale. Measurements shall be taken from a fixed reference point and shall have adequate travel clearance so that total ground anchor movement can be measured without resting the device. The jack load should be monitored with a load cell. Each load increment shall be fully applied as rapidly as possible (preferable in less than 30 seconds after the jack pump is started).

When the theoretical elastic elongation of the total anchor length at the maximum test load exceeds the jack's ram length, the procedure for recycling the jack ram must be approved by the Engineer. The load testing shall be proceeded by incrementally loading the ground anchor in accordance with the following schedule. The load shall be raised from one increment to another immediately after recording the ground anchor movement.

Test Load Schedule

AL
0.25 DL
0.50 DL
0.75 DL
1.00 DL
1.20 DL
1.33 DL
1.0 DL - LO
Where: AL = Alignment Load
DL = Design Load
LO = Lock Off Load

Except for the 1.33 DL load, each load shall be held until movement stabilizes, but a minimum of 1 minute, and the ground anchor movement measured to the nearest 0.001-inch from a fixed reference point. The maximum test load (1.33 DL) shall be held constant for a minimum of 5 minutes with movement measurements made at 0, 0.5, 1, 3 and 5 minutes. If the difference between the 0.5 and 5 minute-measurement is greater than 0.08-inch, then the 1.33 DL shall be held constant for an additional 50 minutes with measurements taken at 15, 20, 30, 45, and 60 minutes. A graph shall be constructed showing a plot of ground anchor movements versus load for each load increment in the test. At the completion of a successful load test, the anchor load shall be reduced to 1.0 DL and transferred to the permanent stressing anchorage. The ground anchor may be completely unloaded prior to lock-off. After transferring the load and prior to removing the jack, a lift-off load reading shall be made. The lift-off load shall be within 10 percent of specified lock-off load. If the load is not within 10 percent of the lock-off load, the anchorage shall be reset and another lift-off reading shall be made. This process shall be repeated until the desired lock-off load is obtained.

a. Proof Loading Testing. Acceptance criteria at the maximum specified test load (1.33 DL) are as follows:

1. The total movement measured at the anchor head shall be greater than 80 percent of the theoretical elastic elongation of the stressing length.

2. The total movement measured at the anchor head shall be less than the theoretical elastic elongation of the tendon length measured from the head of the jack to the center of the installed bond length.

3. The creep movement measured at the anchor head shall be less than 0.08-inch between the 0.5 and 5 minute-readings or less than 0.08-inch between the 5 and 60 minute-readings. The stressing length shall be measured from the stressing anchorage to the bond length top.

If any anchor fails to meet acceptance criteria 1, the Contractor shall either release tension on, or remove the anchor and provide an additional anchor.

If any anchor fails to meet acceptance criteria 2 or 3, the Contractor shall retest the anchor and determine the actual capacity which will produce the acceptance criteria. An additional anchor shall be installed in accordance with this Specification at a location specified by the Engineer and tested to verify if the total capacity of the two anchors exceeds the 1.33 DL load. If it is determined that the anchor failure is through no fault of the Contractor, then compensation will be made for additional anchor(s) and the subsequent testing thereof.

805.04 METHOD OF MEASUREMENT

805.04.1 Permanent Sheet Piling, Temporary Sheet Piling and Temporary Sheet Piling Abandoned in Place. “Permanent Sheet Piling,” “Temporary Sheet Piling,” and “Temporary Sheet Piling Abandoned in Place” each will be measured by the number of square feet of exposed face actually installed in accordance with the Plans and/or as directed by the Engineer. "Exposed face" is measured from the bottom of foundation level or approved excavation level to the top of the adjacent ground surface to be maintained.

805.04.2 Driven Soldier Piles will be measured by the number of soldier piles actually installed in accordance with the Plans and/or as directed by the Engineer.

805.04.3 Pre-drilled Soldier Piles will be measured by the number of soldier piles actually installed in accordance with the Plans and/or as directed by the Engineer.

805.04.4 Drilling or Augering when specified for the installation of soldier piles shall not be measured separately for payment. However, when drilling or augering to remove obstructions is approved by the Engineer, such drilling or augering shall be measured for payment to the nearest linear foot, as calculated from ground surface to the approved depth.

805.04.5 Concrete Backfill around soldier piles shall not be measured separately for payment. Such backfill shall be considered incidental to the installation of the soldier pile.

805.04.6 Lagging Installed will be measured by the number of square feet of lagging actually installed and exposed when excavation is complete in accordance with the Plans and/or as directed by the Engineer. "Exposed face" shall be measured vertically from the bottom of approved excavation to the top of adjacent ground surface, and horizontally between adjacent soldier piles.

805.04.7 Walers, Bracing, and Hardware Fastenings. Where specified and shown on the Plans or as directed by the Engineer, walers and bracing shall be measured by the linear foot of walers and bracing actually installed and suitably secured as specified. Hardware and/or other fastenings shall not be measured separately for payment.

805.04.8 Ground Anchors will be measured by the number of units actually installed in accordance with the Plans and/or as directed by the Engineer. No change in the number of ground anchors to be paid for will be made because of the use, by the Contractor, of an alternative number of ground anchors.

805.05 BASIS OF PAYMENT.

805.05.1 Permanent Sheet Piling, Temporary Sheet Piling, and Temporary Sheet Piling Abandoned in Place. The accepted quantity of "Permanent Sheet Piling," "Temporary Sheet Piling" and “Temporary Sheet Piling Abandoned in Place” 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, and equipment, including driving, bracing, cutting and removal of excess quantities, removal of temporary sheet piling, and all other incidentals required to finish the work, complete and accepted by the Engineer.

805.05.2 Soldier Piles Driven. The accepted quantity of "Soldier Piles Driven" shall be paid for at the contract unit price per each as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, materials, equipment, and all other incidentals required to furnish and install piles, completed and cut off, and accepted by the Engineer.

805.05.3 Soldier Piles Pre-drilled. The accepted quantity of "Soldier Piles Pre-drilled" or pre-augered shall be paid for at the contract unit price per each as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, materials, and equipment to pre-drill and maintain holes including dewatering and clean out, furnish and install piles, other materials including casing, concrete or other specified backfill, and all other incidentals required to finish the work, complete and accepted by the Engineer.

805.05.4 Drilling or Augering to Remove Obstructions. When approved by the Engineer, the accepted quantity of "Pre-drilling or Pre-augering to Remove or Pass Obstructions" shall be paid for at the contract unit price per linear foot as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, materials, and equipment and all other incidentals required to pre-drill, clean out, and maintain holes, complete and accepted by the Engineer.

805.05.5 Lagging Installed. The accepted quantity of "Lagging" shall be paid for at the contract unit price per square foot listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, materials, equipment and all other incidentals required to furnish, install and secure lagging between soldier piles, including removal of concrete backfill as necessary to secure lagging, walers, or bracing to piles, complete and accepted by the Engineer.

805.05.6 Walers and Bracing. The accepted quantity of "Walers and Bracing" shall be paid for at the contract price per linear foot as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, equipment, and materials required to furnish, install, and secure walers and bracing, complete and accepted by the Engineer.

805.05.7 Ground Anchors. The accepted quantity of "Ground Anchors" shall be paid for at the contract unit price per each as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, equipment, tools and materials, and all other

incidentals required to finish the work, including testing, complete and accepted by the Engineer.

SECTION 806

TIMBER CONSTRUCTION

806.01 DESCRIPTION. This work consists of the provision of heavy timber construction for bridge superstructures, roadway decks, sidewalks, railings, and for other similar purposes at the locations indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

806.02 MATERIALS.

806.02.1. Timber. Sawn lumber, structural glued laminated timber and wood preservative treatment shall conform to the requirements of **SECTION M.11; TIMBER.**

806.02.2 Hardware. Metal fastenings required for timber connections or for connecting timber to concrete or steel work shall conform to the applicable requirements of **Subsection M.05.04.13** of these Specifications.

806.03 CONSTRUCTION METHODS.

806.03.1 Workmanship. All timber shall be accurately cut and framed to a close fit in such manner that the joints will have even bearing over the entire contact surfaces. Unless otherwise specified, nails and spikes shall be driven just sufficiently to set the heads flush with the surface of the wood. Deep hammer marks in wood surfaces shall be considered evidence of poor workmanship and shall be deemed sufficient cause for rejection of the work.

806.03.2 Preservative Treatment of Timber and Lumber. All timber and lumber designated for treatment in the Contract Documents shall be treated by the pressure process in accordance with the standard practices of the American Wood Preservers Association (AWPA). AWPA standard specifications and practices for Preservatives, Commodities, Analysis, Miscellaneous Standards, and Evaluation Standards shall be as specified in the Contract Documents. If not so-specified, the appropriate standards and specifications from AWPA for the project conditions shall be utilized. Unless otherwise specified, the pressure process utilized shall be the "empty cell" process, followed by an expansion bath where applicable, vacuum to 22 inches of mercury at sea level and final steam cleaning. The preservative utilized shall be as specified in the Contract Documents.

806.03.3 Handling of Timber and Lumber.

a. Untreated Timber. Untreated timber and lumber at the site of the work shall be open-stacked on supports at least 12 inches above the ground and shall be so stacked and stripped as to permit free circulation of air between the tiers and courses. When required by the Engineer, it shall be protected from the weather by suitable covering.

b. Treated Timber. Treated timber and lumber shall be close-stacked and placed in a position as to facilitate thorough drainage of any preservative remaining on the material and shall otherwise conform to the requirements of AWPA Standard M4.

1. Handling. Treated timber shall be handled carefully without sudden dropping, bruising, breaking of outer fibers or penetrating the surface with tools. It shall be handled with rope or web slings. Cant hooks, peaveys, pikes or hooks shall not be used. Corner protectors shall be provided to prevent damage to timber bundled with metal bands or straps.

2. Cuts and Abrasions. All cutting, framing and boring of treated timber shall be performed before treatment insofar as is practicable. All cuts and abrasions made after treatment shall be given 3 brush coats of hot preservative oil. Each coat shall be allowed to dry before the next coat is applied.

3. Holes. All holes, bored after treatment, shall be treated with preservative oil by means of an approved pressure bolt hole treater or with hot preservative oil by other approved methods. Any unfilled holes, after being treated with preservative oil, shall be plugged with treated plugs.

4. Temporary Attachments. Forms or temporary braces may be attached to treated timber with nails or spikes only when approved by the Engineer. Upon their removal, the holes shall be filled by driving galvanized nails or spikes flush with the surface, or by plugging as required for holes.

806.03.4 Installation of Connectors. The split ring and the shear plate types shall be installed in precut grooves of dimensions as recommended by the manufacturer. Spike grids shall be forced into the wood so that timbers will be in firm contact. Pressure equipment that does not damage the wood shall be utilized.

Connector grooves in timber shall be cut concentric with the bolt hole, shall conform to the cross-sectional shape of the rings, and shall provide a snug fit. Inside groove diameter shall be larger than nominal ring diameter in order that the ring will expand slightly during installation.

Fabrication of all structural members using connectors shall be done prior to preservative treatment. When prefabricated from templates or shop details, bolt holes shall not be more than 1/16-inch from required placement. Bolt holes shall be 1/16-inch larger than the finished bolt diameter. Bolt holes shall be bored perpendicular to the face of the timber.

Timber after fabrication shall be stored in a manner that will prevent changes in the dimensions of the members before assembly. Timber should be cured before fabrication so that it will remain stable in its dimensions. Timber that shrinks during storage causing predrilled grooves for split rings or plates to become elliptical or causing bolt hole spacing to change will be sufficient reason for rejection.

806.03.5 Countersinking. Countersinking shall be done wherever smooth faces are required. Recesses formed in treated timber for countersinking shall be treated as required for cuts and abrasions.

806.03.6 Hardware.

a. Rods. Rods connecting only sawed timbers shall be threaded sufficiently at each end to provide tight connections, allowing only for permissible variations in dimensions of material.

b. Bolts. The length specified shall be the length measured under the head. Bolts may be substituted for rods for timber connections where the length of threaded portion provided by the bolt is sufficient.

c. Lag Screws. Lag screws shall be installed by turning them into place. They may be driven sufficiently to start them into the holes and hold them firmly in place for turning. Pre-drilling shall be performed in accordance with the procedures set forth in **Subsection 806.03.7**, below.

d. Nuts and Washers. Washers or plate washers shall be used under all nuts, bolt heads, and lag screws that would otherwise come in contact with wood, except under large diameter heads of specially designed flat head bolts. All nuts shall be standard square nuts. They shall be tightened sufficiently to prevent the rods or bolts from becoming loose during service and, after being tightened, they shall be effectively secured against backing off by burring of the rod or bolt threads, or as otherwise specified or approved by the Engineer.

e. Nails and Spikes. Nails shall not extend through all material into which they pass except when approved by the Engineer. When so-indicated, nails and spikes shall be driven in the pattern and quantities indicated on the Plans. Distance and spacing requirements shall generally adhere to the following:

End distance (tension members)	15d;
End distance (compression members)	12d;
Edge distance	10d;

when "d" equals the diameter of nails or spikes.

Nails or spikes shall be driven through the thinner member into the thicker member, and be flush or countersunk to the member surface. Pre-bored holes, when required, shall be drilled in accordance with the procedures set forth in **Subsection 806.03.7**, below.

806.03.7 Holes for Bolts, Dowels, Rods, Lag Screws, Nails and Spikes. Holes for round drift bolts and dowels shall be bored with a bit sized 1/16-inch less in diameter than the bolt or dowel to be used. The diameter of holes for square drift bolts or dowels shall be equal to the least dimension of the bolt or dowels.

Holes for machine bolts shall be bored with a bit of the same diameter as the bolt, with a tolerance of plus 1/16-inch; minus zero.

Holes for rods shall be bored with a bit 1/16-inch greater in diameter than the rod.

Holes for lag screws shall be bored with a bit not larger than the body of the screw at the base of the thread. To prevent splitting or stripping of the threads, a lead hole for the shank shall be bored with a bit of the same diameter and to the same depth as the shank. The depth of holes for lag screws shall be one-inch less than the length under the thread. Lag

screws shall not be driven into the lead hole with a hammer but shall be turned in by means of a wrench.

Spikes and nails are generally hand-driven but may be power driven for the smaller diameters and lengths. Holes for large diameter spikes and nails (generally greater than 1/4-inch) shall be pre-bored to prevent the wood from splitting during driving. The diameter of the lead hole must not exceed 0.9 times the diameter of the fasteners for wood species with specific gravities greater than 0.6, and no more than 0.75 times the diameter of the fastener for wood species with specific gravities less than 0.6. Pre-bored holes shall not extend into the members which will be holding the point of the nail or spike.

806.03.8 Framing. All lumber and timber shall be accurately cut and framed to a close fit in such manner that the joints will have even bearing over the entire contact surfaces. Mortises shall be true to size for their full depth and tenons shall fit snugly. No shimming will be permitted in making joints, nor will open joints be accepted.

806.03.9 Framed Bents.

a. Mud Sills. Mud sills shall be firmly and evenly bedded to solid bearing and tamped in place. Mud sills shall be pressure preservative treated for ground contact. Where untreated timber is permitted for mud sills, it shall be of heart cedar, heart cypress, redwood, or other durable timber as approved by the Engineer.

b. Concrete Pedestals. Concrete pedestals for the support of framed bents shall be carefully finished so that the sills or posts will take even bearing. Dowels for anchoring sills or posts shall be not less than 3/4-inch in diameter and project at least 6 inches above the tops of the pedestals. These dowels shall be cast in the concrete pedestals.

c. Sills. Sills shall have true and even bearing on mud sills, piles, or pedestals. They shall be drift-bolted to mud sills or piles with bolts of not less than 3/4-inch diameter and extending into the mud sills or piles at least 6 inches, or by other types of connectors as detailed on the Plans. When possible, all earth shall be removed from contact with sills so that there will be free air circulation around the sills.

d. Posts. Posts shall be fastened to pedestals with dowels of not less than 3/4-inch diameter, extending at least 6 inches into the posts, or by other types of connectors as detailed on the Plans.

Posts shall be fastened to sills by one of the following methods, as indicated on the Plans:

1. By dowels of not less than 3/4-inch diameter, extending at least 6 inches into posts and sills.

2. By drift-bolts of not less than 3/4-inch diameter driven diagonally through the base of the post and extending at least 9 inches into the sill. Drift bolts shall be driven in holes at a 45 degree angle and shall enter the post at least 6 inches above the post base.

3. By other types of connectors as detailed on the Plans.

e. Caps. Timber caps shall be placed, with ends aligned, in a manner to secure an even and uniform bearing over the tops of the supporting posts or piles. All caps shall be secured by drift-bolts of not less than 3/4-inch diameter, extending at least 9 inches into the posts or piles, or by other types of connectors as detailed on the Plans. The drift-bolts shall be approximately in the center of the post or pile.

f. Bracing. Bracing shall be bolted through the pile, post, or cap at the ends and at all intermediate intersections using a bolt of not less than 5/8-inch in diameter. Bracing shall be of sufficient length to provide a minimum distance of 8 inches between the outside bolt and the end of the brace.

806.03.10 Stringers. Stringers shall be sized at bearings and shall be placed in position so that knots near edges will be in the top portions of the stringers.

Other stringers may have butt joints with the ends cut on a taper, but interior stringers shall be lapped to take bearing over the full width of the floor beam or cap at each end. The lapped ends of untreated stringers shall be separated at least ½-inch for the circulation of air and shall be securely fastened by drift-bolting where specified. When stringers are two panels in length the joints shall be staggered.

Timber stringers shall be placed in position so that the deck will have an even bearing on all stringers and so that any knots near edges will be in the top portions of the stringers. Outside stringers may have butt joints, centered over caps or floor beams, but interior stringers shall be lapped to take bearing over the full width of the cap or floor beams at each end. Unless otherwise shown on the Plans, stringers shall be toe-nailed to caps, and intermediate stringers of adjoining spans shall be spiked together where they lap.

Cross-bridging between stringers shall be neatly and accurately framed, and securely toe-nailed with at least 2 nails in each end. All cross-bridging members shall have full bearing at each end against the sides of stringers. Unless otherwise specified, 2" x 4" cross-bridging shall be placed at the center of each span.

806.03.11 Plank Floors. Unless otherwise specified, planks for flooring shall be surfaced four sides (S 4 S).

Single plank floors shall consist of a single thickness of plank supported by stringers or joists. The planks shall be laid heart side down, with 1/4-inch openings between them for seasoned material and with tight joints for unseasoned material. Each plank shall be securely spiked to each joist. The planks shall be carefully graded as to thickness and so laid that no two adjacent planks shall vary in thickness by more than 1/8-inch.

Two-ply timber floors shall consist of two layers of flooring supported on stringers or joists. The top course shall be laid either diagonal or parallel to the centerline of roadway, as specified, and each floor piece shall be securely fastened to the lower course. Joints shall be staggered at least 3 feet. If the top flooring is placed parallel to the centerline of the roadway, special care shall be taken to securely fasten the ends of the flooring. At each end of the bridge these members shall be beveled.

806.03.12 Nailed or Glued Laminated Strip Floors. Nailed or glued laminated strip floors consist of individual lumber strips placed on edge and nailed, glued or nailed, and glued to the

previous strip thereby forming a continuous surface. The laminated strip floors may be constructed on top of stringers at right angles to the centerline of roadway or they can be constructed on top of floor beams and run parallel to the roadway centerline.

Spikes shall be of sufficient length to pass through two strips and at least one-half way through the third strip. The size of spikes shall be as indicated on the Plans. If timber supports are used, every other strip shall be toe-nailed to every other support. If steel supports are used, the strips shall be securely fastened to the supports at the locations and spacing indicated on the Plans. The attachment device shall be approved galvanized clips as detailed on the Plans.

Care shall be exercised in order that each strip shall be vertical and tight against the preceding strip and shall bear evenly on all supports.

806.03.13 Laminated Panel Decks. Laminated panel decks consist of stress laminated sawn lumber strips placed with their wide side vertical and fastened together to form panels. Fastening may be accomplished by nails, glue, glue and nails, or dowels. Panels may be interconnected utilizing spliced, bolted, or doweled ship-lap joints; steel dowels; or high strength steel stressing rods. Alternatively, panels may be assembled in a non-interconnected fashion.

Panels may be utilized longitudinally with stringers, composite stringers, without stringers, or transversely across steel or wood stringers.

806.03.14 Wheel Guards and Railings. Wheel guards and railings shall be accurately framed in accordance with the Plans and erected true to line and grade. Unless otherwise specified, wheel guards, rails, and rail posts shall be surfaced four-sides (S 4 S). Wheel guards shall be laid in sections not less than 12 feet long, except where necessary to match expansion joints or end joints.

806.03.15 Trusses. Trusses, when completed, shall show no irregularities of line. Chords shall be straight and true from end to end in horizontal projection and, in vertical projection, shall show a smooth curve through panel points conforming to the correct camber. All bearing surfaces shall fit accurately. Uneven or rough cuts at the points of bearing shall be cause for rejection of the piece containing the defect.

806.04 METHOD OF MEASUREMENT. Unless otherwise specified in the Special Provisions/Construction section of project specifications, "Timber Construction" will be measured by the number of thousand board feet actually placed in various parts of the completed structure in accordance with the Plans and/or as directed by the Engineer. Computation of quantity will be based on the nominal commercial widths and thicknesses of the respective materials.

806.05 BASIS OF PAYMENT. Unless otherwise specified in the Special Provisions/Construction section of project specifications, "Timber Construction" will be paid for at the contract unit price per thousand board feet as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, and equipment, including all lumber, preservative treatment, hardware, and all other incidentals required to finish the work, complete and accepted by the Engineer.

SECTION 807

MASONRY CONSTRUCTION

807.01 DESCRIPTION. This work consists of the construction of masonry structures and masonry portions of composite structures of various types at the locations indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

807.01.1 Cut Stone Masonry (Ashlar). Cut stone masonry or masonry veneer shall be dressed and tooled to fixed dimensions as indicated on the Plans or otherwise specified, and shall be laid in range or random courses in a cement mortar bed.

807.01.2 Split Face Masonry. Split face masonry or veneer shall be composed of quarry stone laid in range or random courses in a cement mortar bed; shall be substantially level and follow the pattern shown on the Plans. It shall include, unless otherwise specified, coping, quoin and belt stones shaped to line and grade. A reasonable proportion of the joints shall be splayed from the vertical as indicated. Split faced masonry may consist of a fascia wall one stone thick backed with concrete or constructed of solid stone masonry.

807.01.3 Rubble Masonry. Rubble masonry shall be composed of irregular stones laid as coursed or uncoursed rubble in a cement mortar bed. Rubble masonry may consist of either a fascia wall one stone thick backed with concrete or constructed of solid stone masonry. Rubble masonry shall be constructed in accordance with the applicable requirements of **SECTION 911; STONE MASONRY WALLS**, of these Specifications.

807.01.4 Dry Rubble Masonry. Dry rubble masonry shall be composed of irregular stones laid as coursed or uncoursed rubble without the use of cement mortar. Dry rubble masonry shall be constructed in accordance with the applicable requirements of **SECTION 912; REMOVE AND REBUILD DRY STONE MASONRY WALLS**, of these Specifications.

807.01.5 Concrete Block or Brick Masonry. Concrete block and brick masonry shall consist of concrete blocks or brick laid in cement mortar and may be unreinforced or reinforced with steel reinforcing. Block or brick pavements are not included under this designation.

807.02 MATERIALS.

807.02.1 Stone. Stone shall be the material indicated on the Plans and shall otherwise conform to the applicable requirements of **SECTION M.14**, of these Specifications.

807.02.2 Block and Brick.

a. Concrete Block. Unless otherwise specified in the Special Provisions or approved in writing by the Engineer, all concrete block for masonry construction shall be Type I moisture controlled units (Grade N-I) that meet the requirements of ASTM C90. The value of f'_m shall be as shown on the Plans or as specified in the Special Provisions.

Concrete block units should be protected from rain, snow, or other moisture during storage on or off the job site to assure that they will meet the Type I moisture requirements at the time they are placed in the construction.

b. Brick. Brick for masonry construction shall conform to the Specification for Building Brick (solid masonry units made from clay or shale) AASHTO M114 (ASTM C62), Concrete Building Brick (ASTM 55), or Solid Load-Bearing Concrete Masonry Units (ASTM 145). The type and grade of brick to be furnished shall be as shown on the Plans or as specified in the Special Provisions.

The bricks shall have a fine-grained, uniform, and dense structure, free from lumps of lime, laminations, cracks, checks, soluble salts, or other defects which may in any way impair their strength, durability, appearance, or usefulness for the purpose intended. Bricks shall emit a clear, metallic ring when struck with a hammer.

807.02.3 Mortar. Mortar shall conform to the requirements of **Subsection M.04.03.5**, of these Specifications.

807.02.4 Lead, Dowels, and Cramps. Leaded joints, wrought iron and galvanized steel dowels or cramps shall conform to the applicable requirements of **SECTION M.05** of these Specifications.

807.02.5 Concrete. Concrete backing of stone fascia walls shall be Class A(AE) and shall develop a minimum compression strength of 3,000 psi when tested at 28 days; and shall otherwise conform to the applicable requirements of **SECTION 601; PORTLAND CEMENT CONCRETE**.

807.02.6 Reinforcing Steel. Reinforcing steel shall conform to the requirements of **Subsection M.05.01** of these Specifications.

807.02.7 Grout. Grout for filling voids in hollow masonry units shall conform either to the requirements of ASTM C476 or the following requirements:

a. Fine Grout. For fine grout, if proportioned by volume, the cementitious materials shall consist of one part Portland cement to no more than 1/10 part hydrated lime or lime putty and the aggregates shall consist of sand in the amount of 2¼ to 3 times the total volume of cementitious materials.

b. Coarse Grout. For coarse grout, the proportions shall be the same as for fine grout except that coarse aggregate in the amount of 1 to 2 times the total volume of cementitious materials shall be added. Coarse aggregate shall be of either ½-inch or 3/8-inch maximum gradation.

807.02.8 Sampling and Testing. Sampling and testing shall be in accordance with the Rhode Island Department of Transportation Project Schedule for the Sampling, Testing and Certification of Material and/or as modified by these Specifications.

807.03 CONSTRUCTION METHODS.

807.03.1 Weather Limitations. Stone, brick or block masonry utilizing mortar or grout shall not be constructed when the temperature is below 40°F, when the respective units contain frost, or when the temperature is expected to drop below 40°F within 24 hours of placement, except with the written permission of the Engineer and subject to such conditions as he or she may require. Such permission and the use of the methods prescribed shall not release the Contractor from his

obligation to build a satisfactory structure. All work damaged by cold weather shall be removed and replaced. In hot or dry weather the masonry shall be satisfactorily protected from the sun and cured by keeping the masonry or its covering wet for a period of three days after completion.

807.03.2 Mixing of Mortar and Grout. The mortar and grout for masonry construction shall be proportioned as specified above in **Subsections 807.02.3 and 807.02.7**, respectively, of these Specifications.

The mortar shall be hand or machine mixed, as may be required by the Engineer. In the preparation of hand-mixed mortar, the sand and cement shall be thoroughly mixed together in a clean, tight mortar box until the mixture is of uniform color, after which clean water shall be added in such quantity as to form a stiff plastic mass. Machine-mixed mortar shall be prepared in an approved mixer and shall be mixed not less than 3 minutes nor more than 10 minutes. Sufficient water shall be added to make the mortar of such consistency that it can be handled easily and spread with a trowel.

Mortar and/or grout shall be mixed only in those quantities required for immediate use. Mortar not used within 45 minutes after water has been added or before initial set begins, whichever occurs first, shall be discarded.

807.03.3 Stone Masonry Construction.

a. Manufacture of Stone for Masonry.

1. General. Each stone shall be free from depressions and projections that might weaken it or prevent it from being properly bedded, and shall be of a shape to meet the requirements for the class of masonry specified.

When no dimensions are shown on the Plans, the stones shall be furnished in the sizes and face areas necessary to produce the general characteristics and appearance as indicated on the Plans.

The thickness of courses, if varied, shall diminish regularly from bottom to top of wall. The size of ring stones in arches shall be as shown on the Plans.

When headers are required, their lengths shall be not less than the width of bed of the widest adjacent stretcher plus 12 inches.

2. Surface Finishes. For the purpose of this Specification the surface finishes of stone are defined as follows:

Smooth-finished: Having a surface in which the variations from the pitch line do not exceed 1/16-inch.

Fine-finished: Having a surface in which the variations from the pitch line do not exceed 1/4-inch.

Rough-finished: Having a surface in which the variations from the pitch line do not exceed ½-inch.

Scabbled: Having a surface in which the variations from the pitch line do not exceed 3/4-inch.

Rock-faced: Having an irregular projecting face without indications of tool marks. The projections beyond the pitch line shall not exceed 3 inches and no part of the face shall recede back of the pitch line.

3. Rubble Masonry.

(a) Size. Individual stones shall have a thickness of not less than 8 inches and a width of not less than 1½ times the thickness. No stones, except headers, shall have a length less than 1½ times their width.

(b) Shape. The stones shall be roughly squared on joints, beds, and faces. Selected stone, roughly squared and pitched to line, shall be used at all angles and ends of walls. If specified, all corners or angles in exterior surfaces shall be finished with a chisel draft.

Bed surfaces of face stones shall be normal to the faces of the stones for about 3 inches and from this point may depart from normal not more than 2 inches in 12 inches. Joint surfaces of face stones shall form an angle with the bed surfaces of not less than 45 degrees.

All shaping or dressing of stone shall be done before the stone is laid in the wall, and no dressing or hammering which will loosen the stone will be permitted after it is placed.

(c) Dressing. Stone shall be dressed to remove any thin or weak portions. Face stones shall be dressed to provide bed and joint lines with a maximum variation from true line of 1½-inches unless otherwise indicated on the Plans or in the Special Provisions.

4. Ashlar Masonry.

(a) Size. The individual stones shall be large and well proportioned. They shall not be less than 12 inches nor more than 30 inches in thickness.

(b) Dressing. Stones shall be dressed to exact sizes and shapes before being laid and shall be cut to lie on their natural beds with top and bottom truly parallel. Hollow beds will not be permitted. The bottom bed shall be the full size of the stone and no stone shall have an over-hanging top. In rock-face construction the face side of any stone shall not present an undercut contour adjacent to its bottom arris giving a top-heavy, unstable appearance when laid.

Beds of face stone shall be fine-finished for a depth of not less than 12 inches.

Vertical joints of face stone shall be fine-finished and full to the square for a depth of not less than 9 inches.

Exposed surfaces of the face stone shall be given the surface finish indicated on the Plans, with edges pitched to true lines and exact batter. Chisel drafts 1½-inches wide shall be cut at all exterior corners. Face stone forming the starling or nosing of piers shall be rough-finished unless otherwise specified.

Holes for stone hooks shall not be permitted to show in exposed surfaces.

(c) Stretchers. Stretchers shall have a width of bed or not less than 1½ times their thickness. They shall have a length of bed not less than twice nor more than 3½ times their thickness, and not less than 3 feet.

5. Arch Ring Stones. Arch ring stone joint surfaces shall be radial and at right angles to the front faces of the stones. They shall be dressed for a distance of at least 3 inches from the front faces and the soffits, from which points they may depart from a plane normal to the face not to exceed 3/4-inch to 12 inches. The back surface in contact with the concrete of the arch barrel shall be parallel to the front face and shall be dressed for a distance of 6 inches from the intrados. The top shall be cut perpendicular to the front face and shall be dressed for a distance of at least 3 inches from the front.

When concrete is to be placed after the masonry has been constructed, adjacent ring stones shall vary at least 6 inches in depth.

Stratification in arch ring stones shall be parallel to the radial joints and in other stones shall be parallel to the beds.

When specified in the Special Provisions, a full-size template of the arch ring shall be laid out near the quarry site, showing face dimensions of each ring stone and thickness of joints. The template shall be approved by the Engineer before the shaping of any ring stone is started, and no ring stone shall be placed in the structure until all ring stones have been shaped, dressed, and approved by the Engineer.

b. Selection and Placing of Stone.

1. General. When masonry is placed on a prepared foundation bed, the bed shall be firm and normal to, or in steps normal to, the face of the wall, and approved by the Engineer before any stone is placed. When it is placed on foundation masonry, the bearing surface of the foundation masonry shall be cleaned thoroughly and in a saturated-surface dry condition when the mortar bed is spread.

All masonry shall be constructed by experienced workmen. Face stones shall be set in random bond to produce the effect shown on the Plans.

Care shall be taken to prevent the bunching of small stones or stones of the same size. When weathered or colored stones, or stones of varying texture, are being used, care shall be exercised to distribute the various kinds of stones uniformly throughout the exposed faces of the work. Large stones shall be used for the bottom courses and large, selected stones shall be used in the corners. In general, the stones shall decrease in size from the bottom to the top of work.

Each stone shall be cleaned and thoroughly saturated with water before being set and the bed which is to receive it shall be clean and well moistened. All stones shall be well bedded in freshly made mortar. The mortar joints shall be full and the stones carefully settled in place before the mortar has set. No spalls will be permitted in the beds. No pinning up of stones with spalls will be permitted in beds.

Stone shall not be dropped upon, or slid over the wall, nor will hammering, rolling, or turning of stones on the wall be allowed. They shall be carefully set without jarring the stone

already laid and they shall be handled with a lewis or other appliance that will not cause disfigurement.

In case any stone is moved or the joint broken, the stone shall be taken up, the mortar thoroughly cleaned from bed and joints, and the stone reset in fresh mortar.

2. Rubble Masonry. Rubble masonry shall be laid to line and in courses roughly leveled up. The bottom or foundation courses shall be composed of large, selected stones and all courses shall be laid with bearing beds parallel to the natural bed of the material. The vertical joints in each course of rubble masonry shall break with those in adjoining courses at least 6 inches. In no case shall a vertical joint be so located as to occur directly above or below a header.

3. Ashlar Masonry. For all range cut stone masonry the stone shall be laid with alternate stretchers and headers, shall conform to the general dimensions, shapes and arrangement shown on the Plans. The stones in any one course of ashlar masonry shall be placed so as to form bonds of not less than 12 inches with the stones of adjoining courses. Headers shall be placed over stretchers and, in general, the headers of each course shall equally divide the spaces between the headers of adjoining courses, but no header shall be placed over a joint and no joint shall be made over a header. The thickness of stretches and headers shall be as shown on the Plans or as specified in **SECTION M.14; STONE FOR MASONRY**.

4. Split Face. For all split faced masonry, selected stones, squared and pitched to line, shall be used at all angles, wall expansion and contraction joints, and other arrises. Copings and belt stones shall be dressed for the required jointing and exposed corners shall be pitched parallel to each other. Exposed surfaces shall have projections of not more than 1 inch. The bed and interior ends shall be cut normal to the pitch lines.

5. Sample Section. If required, the Contractor shall build at a location designated, a sample section of wall not less than 5 feet high and 8 feet long, showing examples of face wall and method of forming joints. The sample section shall be subject to the Engineer's approval prior to the start of wall facing.

c. Beds, Joints and Pointing.

1. Beds and Joints. Face joints for all cut stone shall not exceed ½-inch; face joints for split face masonry shall not exceed 1 inch; and face joints for rubble masonry shall not exceed 1½-inches. The joints in the interior of the wall shall average not more than 1½-inches for rubble masonry.

The thickness or beds in ashlar masonry may vary as shown from the bottom to the top of the work. However, in each course the beds shall be of uniform thickness throughout.

Beds shall not extend in an unbroken line through more than five stones.

Joints in ashlar masonry shall be vertical. In all other masonry, joints may be at angles with the vertical from 0 degrees to 45 degrees.

Each face stone shall bond with all contiguous face stones at least 6 inches longitudinally and 2 inches vertically. Ring stone joints on the faces and soffits shall be not less than 1/4-inch nor more than 1½-inches in thickness.

Cross beds for vertical walls shall be level and for battered walls may vary from level to normal to the batter line of the face of the wall. All joints shall be completely filled with mortar.

2. Pointing. Pointing shall not be done in freezing weather or when the stone contains frost.

Whenever possible, face joints shall be properly pointed before the mortar sets. Joints which cannot be immediately pointed shall be prepared for pointing by raking them out to a depth of 2 inches before the mortar has set. The face surfaces of stones shall not be smeared with mortar forced out of joints or that used in pointing.

Joints not pointed at the time the stone is laid shall be thoroughly wet with clean water and filled with mortar. The mortar shall be well driven into the joints and finished with an approved pointing tool. The mortar in joints on top surfaces shall be crowned slightly at the center of the masonry to provide drainage. Walls shall be kept wet while pointing is being performed, and in hot or dry weather the pointed masonry shall be protected from the sun and kept wet for a period of at least 3 days after completion.

After the pointing is completed and the mortar set, the wall shall be thoroughly cleaned and left in a neat and workmanlike condition.

3. Leaded Joints. When shown on the Plans or specified, horizontal and vertical joints shall be leaded to the designated size and depth. The mortar joints shall be raked out clean to the specified depth, but in no case less than 3/4-inch. Joints shall not be leaded before the concrete backing has been placed. Lead wool shall be thoroughly tamped into place with a caulking tool and finished with a bead for the width of the joint.

d. Headers. Headers shall hold in the heart of the wall the same size as shown in the face, and shall extend not less than 12 inches into the core. They shall occupy not less than one-fifth of the face area of the wall and shall be evenly distributed.

Headers in walls 3 feet or less in thickness shall extend entirely through the wall.

Headers in ashlar masonry shall be placed in each course and shall have a width of not less than 1½ times their thickness. In walls having a thickness of 4 feet or less, the headers shall extend entirely through the wall. In walls of greater thickness, the length of headers shall be not less than 2½ times their thickness when the course is 18 inches or less in height, and not less than 4 feet in courses of greater height. Headers shall be spaced not further apart than 8 feet center to center. There shall be at least one header to every two stretchers.

e. Cores and Backing.

1. General. Cores and backing shall consist either of compactly laid and interlocked stones including headers and stretchers or of concrete.

The headers and stretchers in walls having a thickness of 3 feet or less shall have a width or length equal to the full thickness of the wall. No backing or core will be allowed.

2. Stone. When stone is used for cores or backing, at least one-half of the stone shall be of the same size and character as the face stone, and the remaining stones shall be of sizes and shapes that facilitate proper interlocking with face stones. No course shall be less than 8 inches thick.

Stone backing shall be laid in the same manner as specified above for face stone, with headers interlocking with face headers when the thickness of the wall will permit. Backing shall be laid to break joints with the face stone. Stone cores shall be laid in full mortar beds so as to bond not less than 12 inches with face and backing stone and with each other. Bed joints in cores and backing shall not exceed 1 inch in thickness and vertical joints shall not exceed 2 inches in width.

3. Concrete. The placement and consolidation of concrete adjacent to the ashlar masonry facing shall be done in a manner that will insure the filling of all spaces around the stones and secure full contact and efficient bond with all stone surfaces.

4. Leveling Courses. Stone cores and backing shall be carried up to the approximate level of the face course before the succeeding course is started.

5. Concrete Backing.

Unless otherwise specified, the stone masonry shall be constructed before placing concrete.

Steel anchors as shown on the Plans or specified in the Special Provisions shall be used. To improve the bond between the stone masonry and the concrete backing, the back of the masonry shall be made as uneven as the stones will permit.

After the stone facing has been laid and the mortar has attained sufficient strength, all surfaces against which concrete is to be placed shall be cleaned carefully and all dirt, loose material, and accumulations of mortar droppings removed.

When placing concrete all interstices of the masonry shall be filled and the concrete thoroughly spaded and worked until it is brought into intimate contact with every part of the back of the masonry.

Unless otherwise indicated on the Plans, horizontal construction joints in the concrete backing shall be made at grades which will break joints of the stone facing. Concrete courses shall be approximately 4 feet in depth.

f. Dowels and Cramps. Where required, coping stone, stone in the wings of abutments, and stone in piers shall be secured with wrought iron or galvanized steel cramps or dowels as shown on the Plans or ordered by the Engineer.

Dowel holes that will be covered by stone masonry shall be drilled through each stone before the stone is placed and, after it is in place, such dowel holes shall be extended by drilling into the underlying course not less than 6 inches. On those stones where it is desirable to avoid

drill holes through the top surfaces, they shall be concealed by setting and grouting the stones over dowels set in the preceding course, or by some similar method. The size and number of dowel holes and size and length of dowels shall be as shown on the Plans or as directed.

Cramps or dowels shall be of the shapes and dimensions shown on the Plans or approved by the Engineer. They shall be inset in the stone so as to clear the bed of the succeeding course and shall be located in such a manner as to securely bond the stone courses together or stone facing to the concrete backing.

Cramps and dowels shall be set in lead, care being taken to completely fill the surrounding spaces with the molten metal, or shall be rigidly anchored by other means approved by the Engineer.

g. Copings. Stones for copings of wall, pier, and abutment bridge seats shall be carefully selected and fully dimensioned stones. On piers, not more than two stones shall be used to make up the entire width of coping. The copings of abutment bridge seats shall be of sufficient width to extend at least 4 inches under the backwall. Each step forming the coping of a wingwall shall be formed by a single stone which shall overlap the stone forming the step immediately below it at least 12 inches.

Tops of copings shall be given a bevel cut at least 2 inches wide, and beds, bevel cuts, and tops shall be fine-finished. The vertical joints shall be smooth-finished and the copings shall be laid with joints not more than 1/4-inch in thickness. The underside of projecting copings, preferable, shall have a drip bead.

Joints in copings shall be located so as to provide not less than a 12-inch bond with the stones of the under course and so that no joint will come directly under the superstructure masonry plates.

h. Bracing. When, in the opinion of the Engineer, bracing is necessary to hold the stone in proper position, the Contractor shall construct such bracing in a manner satisfactory to the Engineer.

i. Cleaning Exposed Surfaces. All face stones shall be thoroughly cleaned of mortar stains immediately after being laid and while the mortar is fresh. The stones shall be kept clean until the work is completed. After the pointing is completed and the mortar set, the wall shall be thoroughly cleaned and left in a neat and workmanlike condition.

807.03.4 Brick or Block Masonry.

a. Laying Brick and Block. The blocks or bricks shall be laid in such manner as will thoroughly bond them into the mortar by means of the "shove-joint" method; "buttered" or plastered joints will not be permitted. All clay or shale brick must be thoroughly saturated with water before being laid. Dampening of concrete masonry units before or during construction shall not be permitted unless approved by the Engineer. The arrangement of headers and stretchers shall be such as will thoroughly bond the mass and, unless otherwise specified, work shall be of alternate headers and stretchers with consecutive courses breaking joints. Other types of bonding, as for ornamental work, shall be as specified on the Plans.

All joints shall be completely filled with mortar. They shall not be less than 1/4-inch and not more than 5/8-inch in thickness and the thickness shall be uniform throughout. All joints shall

be finished properly as the work progresses and on exposed faces they shall be neatly struck, using the "weather" joint.

No spalls or bats shall be used except for shaping around irregular openings or when unavoidable to finish out a course, in which case full bricks shall be placed at the corners, the bats being placed in the interior of the course.

Each masonry unit shall be adjusted to its final position while mortar is still soft and plastic. Units which are disturbed after mortar has stiffened shall be removed and relayed in fresh mortar.

Vertical cells to be filled with grout shall be aligned to provide a continuous unobstructed opening.

Piers and walls may be built of solid brick work, or may consist of a brick or block shell backed with concrete or other suitable material as specified on the Plans. All details of the construction shall be in accordance with approved practice and to the satisfaction of the Engineer.

b. Placement of Reinforcement. Prior to and during grouting the reinforcing steel shall be securely held in position at the top and bottom and at intermediate points not exceeding 200 bar diameters or 10 feet apart. Bars shall be maintained clear of the cell walls and within plus or minus ½-inch of their planned position transverse to the wall and within plus or minus 2 inches of their planned position longitudinal to the wall.

c. Grouted Brick or Block Construction. Grouted masonry shall be constructed in such a manner that all elements of the masonry act together as a structural element.

Prior to grouting, the grout space shall be clean so that all spaces to be filled with grout do not contain mortar projections greater than ½-inch, mortar droppings or other foreign material. Grout shall be placed so that all spaces to be grouted do not contain voids.

Grout materials and water content shall be controlled to provide adequate fluidity for placement, without segregation.

Size and height limitations of the grout space or cell on the average shall not be less than shown in Table No. 1. Higher grout pours or smaller cavity widths or cell size than shown in Table 1 may be used when approved by the Engineer, if it is demonstrated that grout spaces are properly filled.

When required by Table No. 1, cleanouts shall be provided in the bottom course at every vertical bar but shall not be spaced more than 32 inches on center for solidly grouted masonry. Cleanouts shall be of sufficient size to allow removal of debris.

Units may be laid to the full height of the grout pour and grout shall be placed in a continuous pour in grout lifts not exceeding 6 feet. If construction joints are used in columns of grout, they shall be located at least 1½-inches below the level of a mortar bed joint.

Segregation of the grout materials and damage to the masonry shall be avoided during the grouting process.

Grout shall be consolidated before loss of plasticity in a manner to fill the grout space. Grout pours greater than 12 inches in height shall be mechanically reconsolidated to minimize voids due to water loss. Grout not mechanically vibrated shall be puddled.

Table No. 1 Grouting Limitations

Grout Type	Grout Pour Maximum Height (feet)	Least Clear Dimensions[1] Width of Grout Space (in.)[2]	Cell Dimensions (in. x in.)	Cleanout Required[3]
Fine	1	¾	1½ x 2	No
Fine	5	1½	1½ x 2	No
Fine	8	1½	1½ x 3	Yes
Fine	12	1½	1¾ x 3	Yes
Fine	24	2	3 x 3	Yes
Coarse	1	1½	1½ x 3	No
Coarse	5	2	2½ x 3	No
Coarse	8	2	3 x 3	Yes
Coarse	12	2½	3 x 3	Yes
Coarse	24	3	3 x 4	Yes

Notes:

1 The clear dimension is the cell or group space width less mortar projects.

2 Grout space width shall be increased by the horizontal projection of the diameters of the horizontal bars within the cross section of the grout space.

3 Cleanouts may be omitted if approved provisions are made to keep the grout space clean prior to grouting.

In nonstructural elements, mortar of pouring consistency may be substituted for grout when the masonry is constructed and grouted in pours of 12 inches or less.

Vertical barriers of masonry may be built across the grout space. The grouting of any section of wall between barriers shall be completed in one day with no interruption longer than one hour.

d. Copings, Bridge Seats, and Backwalls. The tops of retaining walls, abutment wingwalls and similarly exposed brick or block work shall be provided, in general, with a stone coping. The underside of the coping shall have a batter or drip bead, at least 1 inch beyond the face of the block or brick work wall. The coping upon an abutment backwall will commonly have no projection beyond its bridge seat face. For thin copings, mortar of the same proportions as used for laying the block or brick may be used to produce precast sections not less than 3 feet nor more than 5 feet in length. No coping shall be less than 4 inches thick.

Copings of piers and abutment bridge seats shall be of Ashlar stone work and shall conform to the requirements of **Para. b.3** of **Subsection 807.03.3** of these Specifications.

807.04 METHOD OF MEASUREMENT.

807.04.1 Stone Masonry. "Structural Stone Masonry" of the types described in this Section will be measured by the number of cubic yards or square feet of exposed wall surface actually placed in accordance with the Plans and/or as directed by the Engineer.

Fascia walls, one stone thick, will be measured by the cubic yard by assuming the stone surfaces as a course having an average thickness of 12 inches.

The volume, in cubic yards, of all railings, cap stones and belt courses will be determined from the dimensions indicated on the Plans.

807.04.2 Pointing and Grouting. When listed as a separate item in the Proposal, "Pointing and Grouting" will be measured by the number of linear feet actually installed in accordance with the Plans and/or as directed by the Engineer.

807.04.3 Block and Brick Masonry. "Concrete Block Masonry" and/or "Brick Masonry" will be measured by the number of cubic yards or the number of square feet, as the case may be, actually placed in the structure in accordance with the Plans and/or as directed by the Engineer.

807.04.4 Concrete Backing. "Concrete Backing" of stone fascia walls will be measured by the number of cubic yards actually placed in accordance with the Plans and/or as directed by the Engineer.

807.05 BASIS OF PAYMENT.

807.05.1 Stone Masonry. The accepted quantity of "Stone Masonry" will be paid for at either the contract unit price per cubic yard or square foot, as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, and equipment, and all other incidentals required to finish the work, complete and accepted by the Engineer.

807.05.2 Pointing and Grouting. The accepted quantity of "Pointing and Grouting" will be paid for at the contract unit price per linear foot as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, and equipment, and all other incidentals required to finish the work, complete and accepted by the Engineer.

807.05.3 Block and Brick Masonry. The accepted quantities of "Concrete Block Masonry" and/or "Brick Masonry" will be paid for at their respective contract unit prices per cubic yard or per square foot, as the case may be, as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, materials and equipment, and all other incidentals required to finish the work, complete and accepted by the Engineer.

Filling material for the interior of the wall, reinforcing steel, and concrete or mortar copings, shall be considered as included in the price paid for number of cubic yards or square feet of block or brick masonry actually placed.

807.05.4 Concrete Backing. The accepted quantity of "Concrete Backing" of stone fascia walls will be paid for at the contract unit price per cubic yard as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, and equipment, and all other incidentals required to finish the work, complete and accepted by the Engineer.

SECTION 808

CAST-IN-PLACE STRUCTURE CONCRETE MASONRY

808.01 DESCRIPTION. This work consists of the provision of cast-in-place concrete in bridges, walls, culverts, and other miscellaneous structures at the locations and to the details indicated on the Plans, or as directed by the Engineer, all in accordance with these Specifications. The work includes structures constructed by cast-in-place methods using either plain or reinforced concrete, or a combination of both.

808.01.1 Related Items of Work Covered Elsewhere. Related items of work covered in other Sections of these Specifications include the following:

a. **SECTION 810; REINFORCING STEEL**

b. **SECTION 811; PAVEMENT SUBDRAINS AND WALL DRAINS.**

c. **SECTION 812; WATER STOPS AND FLASHINGS**

d. **SECTION 823; ROADWAY JOINTS, EXPANSION AND FIXED**

808.02 MATERIALS.

808.02.1 Concrete. All materials required for the production and curing of structure concrete shall conform to the applicable requirements of **SECTIONS 601 and M.02; PORTLAND CEMENT CONCRETE and SECTION 605; CONCRETE WITH CALCIUM NITRITE BASED CORROSION INHIBITOR**, respectively, of these Specifications.

808.02.2 Joint Fillers and Sealants. The following materials shall conform to the applicable requirements of the indicated Subsections of **PART M; MATERIALS**:

a. **Subsection M.02.10.1; Preformed Joint Filler.**

b. **Subsection M.02.10.2; Poured Joint Sealer**.

c. **Subsection M.02.10.3; Preformed Neoprene Compression Seals.**

d. **Subsection M.02.11.1; Preformed Expansion Joint Filler**, the bituminous type; the non-extruding type; and the polyethylene foam joint filler type.

e. **Subsection M.02.11.2; Joint Seal**. (Poured and Caulked Types)

f. **Subsection M.02.11.3; Mastic Joint Sealer.**

g. **Subsection M.02.11.5; Polyurethane Joint Sealant**.

h. **Subsection M.02.11.6; Polyurethane Elastomeric Joint Sealant**.

808.03 CONSTRUCTION METHODS.

808.03.1 General. The requirements for classification, proportioning, batching, mixing, transportation, placing, curing, and testing of concrete shall conform to the requirements of **SECTION 601; PORTLAND CEMENT CONCRETE.**

808.03.2 Footings. Preparation of foundations shall conform to the requirements of **SECTION 203; STRUCTURE EXCAVATION AND BACKFILL**. No concrete shall be placed until after the Engineer has approved the depth and dimensions of the excavation, the character of the material and the condition of the foundation. No footing shall be supported partially on rock and partially on soil. The rock shall be excavated as necessary to allow the placement of 12 inches of gravel in accordance with **Subsection 203.03.1; Excavation**. The Engineer may direct, in writing, such changes in dimensions or elevations of footings as may be necessary to obtain satisfactory foundations. The Plans will be revised accordingly.

a. Foundations Under Water. When required by the Contract Special Provisions, foundations to be constructed under water shall be inspected by divers hired by the Contractor independently and solely for the purpose of the inspection requirements of the Contract. The diver shall be a professional engineer registered by the State of Rhode Island and shall be appropriately certified to perform the intended work.

In general, the diver's tasks shall include inspection of the excavations for foundations to determine their completeness and suitability for the placement of concrete, inspection of the drilling and grouting operations for any dowels that may be specified, and inspection of the tremie placement operations to insure that the concrete placement is proceeding properly and is completed in accordance with applicable contract Specifications.

The diver shall be responsible to report any discrepancies in materials or workmanship to the Engineer. The diver shall record his/her findings by written and photographic methods and a final report of findings, recommendations and actions taken shall be prepared for the Engineer. Measurement and payment for the diving services shall be as outlined in the Special Provisions.

808.03.3 Falsework and Centering. All falsework or centering shall be adequate for the type of construction involved and shall conform to the requirements of Paragraph 3.2; Falsework and Forms, of the AASHTO Standard Specifications for Highway Bridges, latest revision. The Contractor shall submit all shop drawings for falsework and centering, including design computations formally signed and sealed by the Contractor's Rhode Island Registered Professional Engineer, all in accordance with **Subsection 105.02; Plans and Shop Drawings**, of these Specifications.

The Contractor's professional engineer shall certify that the falsework system has been assembled and constructed according to the approved falsework drawings, prior to placing loads on such falsework.

When structures are to be constructed over railroad tracks, the centering shall also conform to the requirements of the railroad company as to temporary operating clearances, safety and design.

808.03.4 Forms.

a. General. When required, the Contractor shall prepare detailed plans for all important forms. This requirement includes design computations formally signed and sealed by the Contractor's Rhode Island Registered Professional Engineer, and otherwise in accordance with **Subsection 105.02; Plans and Shop Drawings**, of these Specifications. Such plans shall be approved by the Engineer before any work is started on construction of the forms. So-called snap ties shall not be used, and removable cones shall be of minimum diameter. Where forms are to be suspended from the structural steel girders, snap-tie hangers, wires or other devices that cannot be readily adjusted to provide mortar-tight joints will not be approved. Slab forms shall not bear on interior diaphragms.

Forms shall not be installed over steel supporting members until after the steel erection and touch-up painting is completed.

Provision shall be included in the form for a standard 3/4-inch symmetrical chamfer at all square entrant concrete corners unless otherwise indicated on the Plans.

b. Wood Forms. All face forms shall be constructed of lumber 3/4-inch or more in thickness lined with pressed wood-fibre or plywood not less than 1/4-inch in thickness. Sheet metal (preferably noncorrosive) of approved gauge may be substituted.

As an alternate method of construction, face forms may be made up of plywood, 5/8-inch or more in thickness, without backing boards if properly designed and supported. Such alternate construction shall provide a rigid form which will prevent unacceptable deformations in the finished concrete surface.

All pressed wood-fibre or plywood forms shall be suitably tempered or waterproofed at the time of manufacture to prevent the absorption of moisture and shall be of an approved type.

When lining is used, the wood forms shall be of the usual construction with the boards closely spaced. The lining shall be in sheets of maximum useable size and shall be applied smooth side to the concrete. Joints between panels shall be taped or filled to provide a smooth, tight form surface.

Metal ties or anchorages which are required within the forms to hold them to correct alignment and location shall be so constructed that the metal work can be removed to a depth of at least 2 inches from the exposed surface of the concrete without causing injury to such surface by spalling or otherwise. When permitted for secondary forms, all wires, upon removal of the forms, shall be cut back at least ½-inch from the face of the concrete with sharp chisels or nippers.

All fittings for metal ties shall be of such design that, upon their removal, the cavities which are left shall be of the smallest possible size. The cavities shall be filled with cement mortar of fine aggregate and cement in the proportion that has been employed for the particular class of concrete treated, and the surface left smooth, even and uniform in color.

Formwork lines shall be straight and true and forms shall be mortar-tight and well tied and braced to prevent bulging. Block shims or wedges must be properly secured before placing

concrete. Formwork shall be treated with a form release agent approved by the Engineer or be saturated with water just before placing concrete.

The form release agent used shall not discolor or otherwise injuriously affect the concrete surface or subsequent finish. Release agents must be applied to the forms before the reinforcement is placed. All excess release agent shall be removed from the face surfaces, and the ties and reinforcement shall be thoroughly cleaned with an approved solvent where necessary.

c. Metal Forms. The applicable requirements for wood forms shall apply to metal forms. The metal used for forms shall be of such thickness that the forms will remain true to shape. All bolt and rivet heads shall be countersunk. Clamps, pins or other connecting devices shall be designed to hold the forms rigidly together and to allow removal without injury to the concrete. Metal forms which do not present a smooth surface or line up properly shall not be used. Special care shall be exercised to keep metal forms free from rust, grease or other foreign matter which will discolor the concrete.

808.03.5 Placing Concrete (Conventional Method).

a. General. In preparation for the placing of concrete, all sawdust, chips, standing water and other construction debris and extraneous matter shall be removed from the interior of forms. Struts, stays and braces, serving temporarily to hold the forms in correct shape and alignment, pending the placing of concrete at their locations, shall be removed when the concrete placing has reached an elevation rendering their service unnecessary. These temporary members shall be entirely removed from the forms and not buried in the concrete, unless directed otherwise by the Engineer. Any hardware allowed to remain in the formwork shall be cut back to the design cover for reinforcement. The resulting recess in the concrete surface shall then be filled with a patching mortar approved by the Engineer.

The Contractor will be required to notify the Engineer twenty-four hours in advance of placing concrete in order to provide ample time for the inspection of forms, steel reinforcement, materials and equipment.

Concrete shall be placed and consolidated by methods that will neither cause segregation of materials nor displacement of reinforcement and that will result in a dense homogeneous concrete which is free of voids and rock pockets. Prior to the actual placement of concrete, the Engineer may require the Contractor to demonstrate the capability of the equipment to convey the concrete mixture to maintain the specified quality. If the quality of concrete reaching the form is found to be inadequate as a result of the method of concrete placement, the Engineer may order the work to be discontinued and require the substitution of a satisfactory method of concrete placement.

The use of aluminum for chutes on pipes shall not be permitted.

Open chutes shall be of metal or metal lined. Where steep slopes are required, the chutes shall be equipped with baffles erected in short lengths to slow the movement of concrete.

Concrete shall not be dropped a distance of more than 5 feet, and special care shall be taken to fill each part of the form by depositing the concrete as near to its final position as possible. Where placing operations would involve dropping the concrete more than 5 feet, such

as piers, columns, thin walls, etc., it shall be deposited through sheet metal or other approved pipes. As far as practical, pipes shall be kept full of concrete during placing, and their lower ends shall be kept buried in the newly placed concrete.

All chutes and pipes shall be kept clean and free from coatings of hardened concrete by thoroughly flushing with water after each run.

Concrete shall be consolidated by mechanical, high frequency internal or external vibrators, or both, in a manner acceptable to the Engineer. Vibrators shall be of a type and size suited to the purpose. Handheld vibrators shall be equipped with rubber tipped heads when used to consolidate around epoxy-coated reinforcement.

Vibrators shall be manipulated so as to thoroughly work the concrete around the reinforcement and embedded fixtures and into the corners and angles of forms. The vibration at any point shall of sufficient duration to accomplish thorough consolidation but shall not be prolonged to the point where segregation or bleeding occurs.

Vibration shall not be applied directly to, or through the reinforcement to sections or layers of concrete which have hardened to the degree the concrete ceases to be plastic under such vibration. Vibrators shall not be used to transport concrete in the forms.

Concrete shall be placed in horizontal layers not more than 12 inches thick, except as hereinafter provided. When less than a complete layer is placed in one operation, it shall be terminated in a vertical bulkhead. Each layer shall be placed and consolidated before the preceding course has taken initial set to avoid the formation of a cold joint with the preceding course.

In case the placing of concrete is temporarily delayed, the concrete shall be covered immediately and kept moist to retard initial set until placement can resume. In case the placing of concrete is temporarily discontinued, a construction joint shall be formed immediately. Laitance and other objectionable material shall be cleaned from the new construction joint when placement is scheduled to resume.

To avoid visible joints as far as possible upon exposed faces, the top surface of the concrete adjacent to the forms shall be smoothed with a trowel. Where a "feather edge" might be produced at a construction joint, as in the sloped surface of a wingwall, an inset form shall be used to produce a blocked-out portion in the preceding layer which shall produce an edge thickness of not less than 6 inches in the succeeding layer. Work shall not be discontinued within 18 inches of the top of any face, unless provision has been made for a coping less than 18 inches thick. In such case, and if permitted by the Engineer, the construction joint may be made at the underside of the coping.

Immediately following the discontinuance of placing concrete, all accumulations of mortar splashed upon the reinforcing steel and the surface of forms shall be removed. Dried mortar chips and dust shall not be puddled into the unset concrete. If the accumulations are not removed prior to the concrete becoming set, care shall be exercised not to injure or break the concrete-steel bond at and near the surface of the concrete while cleaning the reinforcing steel.

b. Vertical Members. Concrete for columns, substructure and culvert walls, and other similar vertical members shall be placed and allowed to set and settle for a period of time before

concrete for integral horizontal members, such as caps, slabs or footings is placed. Such period shall be adequate to allow completion of settlement due to loss of bleed water and shall be not less than 12 hours for vertical members over 15 feet in height and not less than 30 minutes for members over 5 feet but not over 15 feet in height. When friction collars or falsework brackets are mounted on such vertical members and unless otherwise approved, the vertical member shall have been in place at least seven days and shall have attained its specified strength before loads from horizontal members are applied.

c. Slabs. Before any slab concrete is placed, an approved templet and finishing tools shall be on hand for striking off the surface of the slab to the required crown, as shown on the Plans.

For bridge deck slabs, refer to **SECTION 814; PLACEMENT OF CONCRETE BRIDGE DECKS**, of these Specifications.

d. Superstructure. Unless otherwise permitted, no concrete shall be placed in the superstructure until substructure forms have been stripped sufficiently to determine the character of the supporting substructure concrete.

Concrete for T-beam or deck girder spans whose depth is less than 4 feet may be placed in one continuous operation or may be placed in two separate operations; first, to the top of the girder stems, and second, to completion. For T-beam or deck girder spans whose depth is 4 feet or more and, unless the falsework is non-yielding, such concrete shall be placed in two operations and at least five days shall elapse after placement of stems before the top deck slab is placed.

Concrete for box girders may be placed in two or three separate operations consisting of bottom slab, girder stems and top slab. In either case the bottom slab shall be placed first and, unless otherwise permitted by the Engineer, the top slab shall not be placed until the girder stems have been in place for at least five days.

e. Arch Rings. The concrete in arch rings shall be placed in such a manner as to load the centering uniformly. Arch rings and ribs preferably shall be cast in a single continuous operation. However, with the permission of the Engineer, they may be divided by radial bulkheads into transverse sections of such size that each section can be cast in a continuous operation. The arrangement of the sections and the sequence of placing shall be as approved by the Engineer and shall be such as to avoid the distortion of the centering and consequent creation of initial stress in the newly placed concrete or its reinforcement. The sections shall be bonded together by suitable keys. Where special key sections are required, the concrete shall be mixed as dry as possible and consolidated by means of vibration. The spandrel walls or columns and the beams shall not be cast until after the centering is struck, and no part of the coping, railing, or floor shall be cast until the spandrel walls or columns are complete.

f. Depositing Concrete Under Water. Concrete shall not be deposited in water except with the approval of the Engineer and under his immediate supervision. In this case the method of placing shall be as specified.

Concrete deposited in water shall conform to the applicable requirements of **Subsection 601.01.1; Classification,** of these Specifications. To prevent segregation it shall be carefully placed in a compact mass in its final position, by means of a tremie or other approved method,

and shall not be disturbed after being deposited. Still water shall be maintained at the point of deposit and the forms under water shall be watertight.

For parts of structures under water, when possible, concrete seals shall be placed continuously from start to finish. The surface of the concrete shall be kept as nearly horizontal as practicable at all times. To insure thorough bonding, each succeeding layer of a seal shall be placed before the preceding layer has taken initial set.

A tremie shall consist of a tube having a diameter of not less than 10 inches, constructed in sections having flanged couplings fitted with gaskets. The tremies shall be supported so as to permit free movement of the discharge over the entire top surface of the work to permit rapid lowering when necessary to retard or stop the flow of concrete. The discharge end shall be closed with an approved type of foot valve at each start of work, to prevent water entering the tube, and all joints shall be sealed so that the concrete may be discharged into the empty tube. The tremie tube shall be kept full to the bottom of the hopper. When a batch is dumped into the hopper, the flow of concrete shall be induced by slightly raising the discharge end but, always keeping it in the mass of deposited concrete. The flow shall be continuous until the work is completed.

Dewatering may not proceed until 7 days after completion of the pour except when prior permission is granted by the Engineer. All laitance or other unsatisfactory material shall be removed from the exposed surface by scraping, chipping or other means such that the surface of the concrete will not be injured.

g. Concrete Exposed to Sea Water. Unless shown otherwise on the Plans, no construction joints shall be allowed between extreme low tide and extreme high tide. In the determination of these ranges due consideration shall be given to wave action, ice formation and other conditions affecting the extreme limits of possible deterioration and disintegration.

h. Cold Weather Concrete. Concrete operations during cold weather shall conform to the requirements of **Subsection 601.03.5; Cold Weather Concrete.**

i. Hot Weather Concrete. Concrete operations during hot weather shall conform to the requirements of **Subsection 601.03.6; Hot Weather Concrete.**

808.03.6 Placing Concrete by Pumping (Optional Method).

a. Pumping. Placement of concrete by pumping will be permitted as approved by the Engineer. The equipment shall be arranged that no vibrations result which might damage freshly placed concrete. Where concrete is conveyed and placed by mechanically applied pressure, the equipment shall be suitable in kind and adequate in capacity for the work. The operation of the pump shall be such that a continuous stream of concrete without air pockets is produced. When pumping is completed, the concrete remaining in the pipe-line, if such is to be used, shall be ejected in such manner that there will be no contamination of the concrete or separation of the ingredients.

b. Handling and Placing Concrete. Concrete shall be placed so as to avoid segregation of materials and displacement of reinforcement. Prior to the actual placement of concrete, the Engineer may require the Contractor to demonstrate the capability of the equipment to both convey the concrete mixture and maintain the specified quality. No further verification of the

equipment's capability will be required unless evidence of nonuniform concrete is observed by the Engineer during placement.

Concrete shall not come in contact with aluminum during conveying and placing operations. When concrete pumps are used, the lines shall have a minimum diameter of 5 inches. The specific pumping equipment which the Contractor proposes to use shall be subject to the approval of the Engineer.

All chutes, troughs and pipes shall be kept clean and free from coatings of hardened concrete by thoroughly flushing with water after each run; water used for flushing shall be discarded clear of the concrete already in place.

Dropping concrete a distance of more than 5 feet or depositing a large quantity at any point and running or working it along the forms shall not be permitted.

Special care shall be taken to fill each part of the form by depositing concrete directly in the form as near to its final position as possible; to work the coarser aggregates back from the face of the concrete; and to force the concrete under and around the reinforcement. After the concrete has taken its initial set, care shall be exercised to avoid jarring the forms or placing any strain on the ends of projecting reinforcement.

c. Design Mix. The Contractor shall have the option to submit for approval by the Engineer a pump mix design formula of the concrete mixture to be used with the specific pumping equipment. The concrete mixture shall meet the specific requirements of **Subsection 601.03.1; Proportioning**, for air content, cement factor, and slump for the various classes of concrete specified.

d. Placing Concrete Under Water. Concrete placed under water shall be placed continuously from start to finish. The surface of the concrete shall be kept as nearly horizontal as practicable. To insure thorough bonding, each succeeding layer of seal shall be placed before the preceding layer has taken initial set. For large pours, more than one tremie or pump shall be used to insure compliance with this requirement.

808.03.7 Expansion, Contraction and Construction Joints.

a. Concrete Joints.

1. General. The type and details of joints and joint fillers in concrete shall be as shown on the Plans. Joints shall be filled or open. Filled joints may be the poured type or filled with a premoulded filler. Materials for joint fillers and sealants are specified in **Subsection M.02.10** of these Specifications.

2. Flashing and Water Stops. Metal flashing or flexible water stops shall be furnished and placed as shown on the Plans. They shall be spliced, welded or soldered to form continuous watertight joints, and shall conform to the requirements of **SECTION 812; WATER STOPS AND FLASHING**.

3. Construction Joints. In order to reduce the size of pours or for other construction reasons, additional joints may be provided at locations approved by the Engineer.

Particular care shall be taken with all bonded construction joints to obtain a bond between subsequent pourings. All laitance and debris shall be carefully chipped and cleaned from the surface of the hardened concrete. The contact areas shall be cleaned with a wire brush, moistened with water and covered with a coating of mortar or neat cement grout. The new concrete shall be placed before the grout has attained its initial set and shall be carefully spaded into position.

Shear keys, steel dowels or inclined reinforcement approved by the Engineer shall be used where necessary to transmit shear, or bond the two sections together.

4. Contraction Joints. Where a definite thickness of joint filler is not indicated on the Plans, bond between adjacent surfaces shall be prevented by coating the surface of the concrete in the section first placed with an approved bond breaking material or a sheet of approved nonstaining fibrous paper, or both, using the coating material as a cementing medium.

5. Expansion Joints. Joints to be sealed shall be thoroughly cleaned of all foreign matter. Joint fillers shall be applied in accordance with **Subsection 808.03.8; Para. a**, below.

808.03.8 Joint Fillers and Sealants.

a. Preformed Polyethylene Foam Joint Filler.

1. Preparation. Joints shall be absolutely dry and thoroughly cleaned of all deleterious material prior to placing the joint fillers and sealants.

2. Installation. The thickness of the joint filler shall be as indicated on the Plans. The preformed joint filler shall be installed in strict accordance with the manufacturer's recommendations.

b. Mastic Joint Sealer.

1. Preparation. Joints shall be absolutely dry and thoroughly cleaned in accordance with the manufacturer's recommendations prior to placing the joint fillers and sealants.

2. Approval Requirements. Prior to its use, the Contractor shall furnish notarized certification that the material proposed meets all the requirements of **Subsection M.02.11.3** of these Specifications. The State will require proof that the proposed mastic system has a proven record of performance as confirmed by actual field tests and successful installations in New England. Those installations cited must be available for inspection by Department personnel. The State may require the Contractor to either conduct laboratory tests at its expense or submit current independent laboratory tests to substantiate compliance with the above requirements.

3. Manufacturer's Representative. The supplier of mastic joint sealer shall furnish the services of a competent field representative of the approved manufacturer, if required to do so by the State. The field representative shall be present at the work site prior to any use of materials to instruct the Contractor, the Inspector or the Engineer on installation and inspection procedures and to inspect the condition of the prepared surfaces. The manufacturer's representative will remain at the job site after work commences until the Inspector or Engineer

are satisfied that the work crew has successfully mastered the technique of installing the mastic system.

4. Installation. Installation of the mastic joint sealer shall be in accordance with the directions of the manufacturer. Duplicate copies of said directions shall be forwarded to the job site with each shipment of material.

c. Polyurethane Joint Sealant.

1. Preparation. All joints shall be cleaned of contaminants and impurities to the depth at which the sealant (and backer rod if detailed) is to be installed. Cleaning shall be by grinding, saw cutting blast cleaning (sand or water), mechanical abrading or a combination of such methods. This operation will provide a sound, clean and frost-free surface for sealant application. All dust, loose particles and other debris shall be blown out with oil free compressed air.

An expanded closed cell polyethylene foam rod backup material shall be installed in joints, or an approved bond breaker tape shall be installed if so detailed on the Plans.

2. Application. A primer shall be applied to the concrete surfaces of the joints. The primer shall be in accordance with the recommendation of the sealant manufacturer and shall not be applied to the backup rod or the bond breaker tape.

The polyurethane joint sealant shall be applied in strict conformance with the manufacturer's recommendations and in no case thicker than ½-inch. The approximate width to depth ratio shall be 2-to-1 for working joints.

The joint shall be tooled using a blunt instrument so that it is slightly concave. A soap solution may be used as a tooling aid.

d. Polyurethane Elastomeric Joint Sealant.

1. Preparation. The preparation requirements for this sealant are identical to those specified above in **Para. c.1** of this Subsection for Polyurethane Joint Sealant.

2. Application. A primer shall be applied to the concrete surfaces of the joints. The primer shall be in accordance with the recommendation of the sealant manufacturer and shall not be applied to the backup rod or the bond breaker tape.

The polyurethane elastomeric joint sealant shall be applied in strict conformance with the manufacturer's recommendations.

The sealant shall not be applied to joints less than 1/4-inch in width. The approximate width to depth ratio shall be 2-to-1 for working joints. The application temperature range is 40°F to 100°F. Sealant shall not be applied when the temperature exceeds these limits.

The joint shall be tooled using a blunt instrument so that it is slightly concave. A soap solution may be used as a tooling aid.

Any spillage shall be cleaned up immediately in accordance with local regulations and the directions of the Engineer.

808.03.9 Curing Concrete. Portland cement concrete shall be cured in accordance with the requirements of **Subsection 601.03.8; Curing**, except as modified herein.

a. Concrete in Massive Pours. For concrete in massive pours (a massive pour is defined as any pour in which the concrete dimensions in 3 directions is 5 feet or more) the Contractor shall thermal cure the concrete so as to maintain a temperature differential between the internal (hottest) and external (coolest) temperature of the concrete to a 70°F maximum.

The Contractor shall, not less than 30 days prior to pouring any concrete which is considered a massive pour, furnish the Engineer with heat flow analysis for each concrete mixture in such a pour, proposed methods for observing, detecting and controlling the thermal differential between the external and internal temperatures and proposed corrective measures, for approval by the Engineer. No massive pour shall be placed until the above submittals are made and approved by the Engineer.

b. Corrective Measures. Corrective measures to control the heat may be accomplished through a combination of the following:

1. Selection of concrete ingredients to minimize the heat generated by hydration of the cement.

2. Cooling component materials to reduce the temperature of the concrete while in its plastic state.

3. Postcooling procedures.

4. Controlling the rate of placing the concrete.

5. Insulating the surface of the concrete to prevent heat loss.

6. Providing supplemental heat at the surface of the concrete to prevent heat loss.

7. Other acceptable methods which may be developed by the Contractor and submitted to the Engineer for review and approval.

c. Minimum Requirements. The Contractor shall as a minimum requirement provide the following:

1. Provide and install, within the concrete placed in each massive pour, temperature sensing devices of a type approved by and at locations as designated by the Engineer. These devices shall be accurate to within ±2^{O}F within the temperature range of -32°F to 212°F. The temperatures shall be recorded automatically by an approved strip-chart recorder furnished by the Contractor.

The sensing system shall contain as a minimum 2 independent sets of sensing devices in order to assure readings if one of the systems fail.

The Engineer may approve manual observation and recording temperatures at 6-hour intervals where conditions warrant.

2. Maintain records of temperature differential.

3. Immediately apply corrective measures approved by the Engineer, when the temperature differential nears 70°F so as to maintain it at 70°F maximum.

808.03.10 Removal of Forms, Falsework and Centering. In general, forms for slabs, beams, pier caps and other support members shall not be removed until the concrete has reached the specified 28-day strength as indicated by the compression tests of field cured cylinders.

When it is desirable to facilitate surface finish, side forms used on ornamental work, railings, parapets and exposed vertical surfaces (except columns) may be removed after 12 hours.

In warm weather, when the average temperature exceeds 50°F, the following periods for the removal of forms and supports may be used as a guide when field operations are not controlled by cylinder tests:

Arch centers (after last pour)	14 days
Centering under beams	14 days
Deck slabs (over 10-foot spans)	7-14 days
Deck slabs (under 10-foot spans)	7 days
Columns and slender piers (depending on height)	2-7 days

In cold weather, or when the average temperature is below 50°F, removal of forms and falsework shall be controlled by results of the compression tests on field cured cylinders.

Falsework and centering for filled arches shall not be struck until fills behind the abutments have been placed up to the spring line. Falsework supporting the deck of rigid frame structures shall not be removed until fills have been placed back of the vertical legs, in accordance with **Subsection 203.03.5; Para. b, Pervious Fill Adjacent to Structures.**

Centers shall be gradually and uniformly lowered in such a manner as to avoid excessive stresses in any part of the structure. In arch structures of two-or-more spans, the sequence of striking centers shall be specified by the Engineer.

Arch centering shall be struck and the arch made self-supporting before the railing or coping is placed.

808.03.11 Concrete Finishes.

a. General. All concrete surfaces shall be finished by experienced concrete finishers. Finishes for concrete bridge decks placed by self-propelled machines shall conform to the requirements of **SECTION 814** of these Specifications. Otherwise the finishes to be applied to different types of surfaces shall be as follows:

1. Float Finish. Tops of walls, piers, abutments, parapets, safety walks, sidewalks and medians.

2. Rubbed Finish. All exposed surfaces visible in elevation, to 1 foot below final ground line and the underside of concrete slabs outside of the fascia beam unless otherwise indicated on the Plans.

3. Bush-hammered or Sand Blasted. As shown on Plans.

b. Float Finish. Float finish for horizontal surfaces shall be achieved by placing excess concrete in the forms and striking it off with a template or screed, forcing the coarse aggregate below the surface. The surface shall then be finished by a wooden float to a smooth true plane. The area under bearing plates shall be finished as nearly as possible to 1/8-inch above the final elevation and then dressed to a uniform level bearing with a carborundum brick or power grinder after the concrete has sufficiently set.

c. Rubbed Finish. The object of this operation is to obtain a surface that is uniform in texture and appearance and free of all imperfections or depressions due to form marks or other causes. In general, it shall be accomplished in two rubbing, the first performed as soon after the removal of forms as the condition of the surface warrants, and the second after the completion of the curing period and any subsequent work that might damage the finished appearance.

The entire surface that is to receive a rubbed finish shall be thoroughly moistened with water and rubbed with a wood float or a fairly coarse carborundum stone, depending on the set of the concrete, to produce a paste on the surface. This rubbing shall be continued as long as necessary to remove form marks and projections and to produce a smooth dense surface without pits or irregularities, but shall not be continued to the extent that it causes noticeable exposure of the coarse aggregate.

No wet rubbing shall be done when atmospheric temperatures of $40^{O}F$ or less may normally be expected, unless the work is protected by a substantial windproof housing.

d. Bushhammered or Sandblasted Finish. This type of finish consists of removing a depth of mortar from the surfaces of the walls in order to expose the aggregates and present a rough texture in accordance with and to the limits shown on the Plans.

The method employed to achieve the desired results shall be by either sandblasting or bushhammering. No chemical retardant applied to the forms shall be used. Enough surface mortar shall be removed in order to expose the aggregate particles in slight relief and provide an overall surface with a uniform rough texture.

Prior to finishing any concrete the Contractor shall cast a test panel approximately 4 foot by 4 foot in a vertical position with a joint in the form work near the approximate middle of the panel and demonstrate the proposed method. This method shall be satisfactory to the Engineer who shall be the sole judge of its acceptability. In the event the first trial panel does not produce satisfactory results, one or more trial panels shall be cast until a satisfactory finish is obtained.

The surfaces to be finished shall be carefully cured. After the forms have been removed all holes shall be patched with an approved mortar and any fins or other protuberances removed to present a roughly even surface. If bushhammering is to be employed, the use of air tools is preferable. No finishing shall be started until the concrete has attained its 28-day strength.

Particular care shall be taken when finishing bevels or corners so as not to damage the lines. After the surfaces are finished, all dust and loose particles shall be removed by brushing with stiff wire brushes or air blasting.

808.04 METHOD OF MEASUREMENT.

808.04.1 Structure Concrete Masonry. "Structure Concrete Masonry" of the types described in this Section will be measured by the number of cubic yards of such concrete actually provided in accordance with the Plans and/or as directed by the Engineer.

a. Deductions. Deduction in volume will be allowed for the following elements embedded in concrete:

1. The volume of major structural steel with the exception of steel sheet piling.

2. The volume of timber piles on the basis of 0.8 cubic feet per linear foot of pile.

3. The volume of concrete on combination piles.

No deduction in volume will be allowed for reinforcing steel, floor drains, weep holes, drainage holes, expansion joint material and minor structural elements embedded in concrete.

808.04.2 Joint Fillers. "Joint Fillers" of the types described in this Section will be measured by the number of square feet of those materials actually installed in accordance with the Plans and/or as directed by the Engineer.

808.04.3 Joint Sealants. "Joint Sealants" of the types described in this Section will be measured by the number of cubic inches or the number of linear feet, as the case may be, actually installed in accordance with the Plans and/or as directed by the Engineer.

808.04.4 Concrete Finishes. "Rubbed Finish" and "Bushhammered, or Sand Blasted Finish" will be measured by the number of square feet actually applied in accordance with the Plans and/or as directed by the Engineer. Float finish and concrete deck or wearing surface finish will not be measured for payment.

808.05 BASIS OF PAYMENT.

808.05.1 Structure Concrete Masonry. The accepted quantities of "Structure Concrete Masonry" will be paid for at the respective contract unit prices per cubic yard as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, materials and equipment, and all other incidentals required to finish the work, complete and accepted by the Engineer.

808.05.2 Joint Fillers. The accepted quantities of "Joint Fillers" will be paid for at the 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, and equipment, and all other incidentals required to finish the work, complete and accepted by the Engineer.

808.05.3 Joint Sealants. The accepted quantities of "Joint Sealants" will be paid for at the respective unit prices per cubic inch or linear foot, as the case may be, as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, materials and equipment, and all other incidentals required to finish the work, complete and accepted by the Engineer.

808.05.4 Concrete Finishes. The accepted quantities of "Rubbed Finish" and "Bushhammered or Sand Blasted Concrete Finish" will be paid for at the 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, and equipment, and for all other incidentals required to finish the work, complete and accepted by the Engineer.

There shall be no separate payment for float finish and concrete deck or wearing surface finish as they are included in the price of the concrete.

SECTION 809

PRECAST/PRESTRESSED STRUCTURE CONCRETE MASONRY

809.01 DESCRIPTION. The work of this Section consists of the provision of precast, pre-stressed, 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 entitled, **Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products**, MNL 116, current edition. This manual will provide 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 for inspection services, as outlined in the method of payment for the days of inspection services as defined below.

b. Definition of Inspection Services. The Department shall conduct inspections of the plant and laboratory, witnessing of trial batches, full-time acceptance testing and part-time independent 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 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 proposal 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. Size and Type. Shop drawings shall be neatly drawn and minimum letter size to produce microfilm negatives. The drawings shall be made in ink on mylar and be of acceptable quality. Shop drawings shall be a standard size (22" x 36") in order to conform to the size of the Plans.

2. 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 prestressed unit.

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

(c) Complete details, including anticipated camber, tensioning force (initial and final), concrete strength (stripping strength for precast, transfer strength for prestressed, and 28-day strength for shipping and payment), class of concrete, and type and location of lifting devices.

(d) Shop drawings shall clearly indicate any deviations from the 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.

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

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

(b) Method and outline of procedure for curing of precast units and test cylinders.

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

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

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

(f) Submission for the Engineer's approval of a detailed plan for curing the required structural elements. This detail plan shall include, but not be limited to, 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 shall be allowed forty-five calendar days to review a set of shop drawings. A set of shop drawings shall be considered 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, M.02; PORTLAND CEMENT CONCRETE** and **SECTION 605; CONCRETE WITH CALCIUM NITRITE BASED CORROSION INHIBITOR**. Trial mixes to verify tolerances and strength requirements shall be performed and approved by the Engineer prior to the start of production.

809.02.3 Steel. Except as noted herein, reinforcing steel shall conform to the requirements of **SECTION 810** of these Specifications. All steel used in the fabrication of precast 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. Bar reinforcement shall meet the requirements of **Subsection M.05.01** of these Specifications, and shall be of the grade specified on the Plans.

2. Wire fabric and spiral wire shall meet the requirements of **Subsection M.05.02** of these Specifications.

3. Chairs or other devices necessary to insure 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.

4. Prestressing steel shall be of the low-lax type and meet the requirements of **Subsection M.05.03** of these Specifications.

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

6. Epoxy Coated Steel. All reinforcing steel and epoxy coatings shall conform to the applicable requirements of **SECTION 810** of these Specifications. All breaks in the epoxy coating shall be repaired with an approved patching material compatible with the epoxy coating on the steel and used in accordance with the manufacturer's recommendations before placement in the form. Epoxy coated tie wires shall be used in conjunction with epoxy coated rebars.

7. 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, shall require the recalibration of the ram with a load cell.

The Contractor shall be required to 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 have full access to the compressive testing machine for testing.

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 shall be monitored and inspected by the Engineer. Work performed in the absence of the Engineer shall be automatically rejected. The Contractor shall keep the Engineer informed of the day-to-day scheduling of operations. The Engineer shall have 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 should 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 steel, carefully aligned, clean, rust-free substantial and firm, securely braced and fastened together and sufficiently tight to prevent

leakage of mortar. 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 will stick to or discolor the concrete shall not be used.

b. Critical Dimensions. Critical dimensions, such as lengths, widths, cable locations, bulkhead locations, camber, 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. Manual 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, mill scale, corrosion, or any foreign material that may prevent bonding between the steel and the concrete, to the satisfaction of the Engineer. Prestressing steel that has sustained physical damage at any time shall be rejected. The development of pitting or other results of corrosion (other than rust stain) shall be cause for rejection, when ordered by the Engineer. Prestressing steel exhibiting rust stains shall be examined to determine if pitting exists, prior to its use. Any coil that is found to contain broken strands shall 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 approval of the Engineer. Tack welding of bar reinforcement shall 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.

All prestressing strands shall be tested prior to use. Three, 7-foot samples shall be taken for each heat number. The Contractor shall have no claims for compensation in the event his work is delayed while waiting approval of the material furnished for 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. Manual 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. Manual 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°F. The final pretensioning shall not be done at temperatures below 20°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. There shall be no more than three beams cast in the same line at the same time.

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 may 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.

a. Moist Curing System. Precast/prestressed concrete elements shall be cured by a moist curing system. 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°F, steam shall be applied during the pre-steaming period to hold the air surrounding the element at a temperature between 50°F and 90°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°F per hour. The curing temperature throughout the enclosure shall not exceed 150°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°F until the stress is transferred to the concrete.

7. Initial curing of precast concrete will be considered complete once the minimum specified transfer 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.

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

809.03.9 Testing.

a. General. All materials required for testing shall be furnished by the Contractor at his own expense. Samples shall be taken by the Engineer except where contractual restrictions are present in which case sampling shall be witnessed by the Engineer. The Contractor shall have no claims for compensation in the event his work is delayed while waiting approval of the materials furnished for testing.

b. Process Control Testing. Process Control Testing of concrete is a mandatory requirement and shall conform to the following Special Provisions:

1. Cylinder specimens for form stripping, detensioning, and shipping will 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. All test cylinders shall be 6 inches in diameter by 12 inches high. When the nominal size of the coarse aggregate in the mix does not exceed 1 inch, the Engineer may direct the use of 4" x 8" cylinder specimens for compressive strength verification. When a 4" x 8" cylinder specimen is used. a 0.95 adjustment

factor shall be applied to the compressive strength test result obtained. This adjusted compressive strength shall be equal to or greater than the minimum compressive strength specified for the standard (6" x 12") cylinder specimens. The Contractor shall cast a sufficient number of concrete test cylinders to insure that enough specimens are available to determine the necessary strength test requirements. The Contractor shall be responsible for furnishing the cylinder molds for all compressive test specimens. Steel molds will be required for high temperature curing (in excess of 120°F) and plastic molds for all the rest.

2. Process control cylinders shall be cast and tested in the presence of the Engineer. The Engineer shall be the sole judge of which cylinders are suitable and shall place his mark and date cast thereon.

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) and 28-day strengths (shipping), respectively.

Each structure shall not be shipped from the plant to the project site unless it has cured for seven days at the plant and obtained the minimum 28-day compressive strength.

If the requirement is not met, any remaining cylinders representing the deficient location shall be tested. If the replacement cylinder reaches the minimum required strength that result shall supersede the previous result. Any remaining test cylinders shall be handled and cured according to AASHTO Specifications.

c. Acceptance Testing. Acceptance testing 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 will be chipped back to sound material to a depth of between 3/4-inch to 1 inch. The strands themselves will 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 will 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 unless otherwise as directed by the Engineer.

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

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

The Engineer shall 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 must 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 must be performed at the cost of the Contractor in the presence of the Engineer. Any repair work not done in the presence of the Engineer will not be accepted.

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

809.04 METHOD OF MEASUREMENT. "Precast, Prestressed Concrete Elements" will be measured as called for in the Special Provisions for the particular item or items of work contained in the Proposal.

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, materials, and equipment, and all other incidentals required to finish the work, 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	$ 80.00
101-to-200 miles	$145.00
201 or more miles	$180.00

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

SECTION 810

REINFORCING STEEL

810.01 DESCRIPTION. This work consists of providing reinforcing steel, both plain and deformed, and coated and uncoated; 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. Epoxy Coatings. Materials and application of epoxy coatings shall conform to the requirements of **Subsection M.05.05; Epoxy Coatings for Bar Reinforcement**, of these Specifications.

1. Prequalified Epoxy Powders. The current list of epoxy powders which has been prequalified by the National Bureau of Standards is presented in the Special Provisions of the Contract.

2. Patching Material. The patching or repair material shall be compatible with the epoxy coating and shall be inert in concrete. The material shall be supplied by the epoxy resin manufacturer, and it must be suitable for repairs made by the installation contractor on areas damaged during fabrication or handling in the field.

3. Basis of Acceptance for Coated Bars. The coating applicator shall furnish Certificates of Compliance with each shipment of coated bars. The Certificate of Compliance shall state that the coated bars conform to the requirements of this Specification and those of relevant ASTM Specifications.

810.03 CONSTRUCTION METHODS.

810.03.1 Bar Schedules and Bending Diagrams. The bar schedules and bending diagrams shown on the Plans are furnished for informational purposes only, and the State does not assume responsibility for their accuracy. The Contractor's bar fabricator shall verify the accuracy prior to preparing order lists and bending diagrams. Any expense incurred in revising the State's bar schedules and bending diagrams in order that they comply with the design drawings shall be borne by the Contractor at no additional cost to the State.

810.03.2 Test Bars. The schedule of bars shown on the Plans shall include extra bars for field sampling, for supplementary analyses; and for weight, tensile and bending tests. In general, one bar of a length sufficient for two samples each, 30 inches long, shall be furnished for testing for each 15 tons or less for a given size bar.

If tests results do not reasonably conform to previous reports or do not conform 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 acceptable results are obtained from both, the material may be accepted. Any material unsuited for use because of inaccuracies in bending, or other properties which render it unfit shall 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 shall 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. Bar Reinforcement. Bent bar reinforcement shall be cold bent to the shapes shown on the Plans. Bars partially embedded in concrete shall not be field bent except as shown on the Plans. Bends and details shall be in accordance with the AASHTO Standard Specifications for Highway Bridges and the Manual of Standard Practice of the Concrete Reinforcing Steel Institute.

Bar reinforcement shall be shipped in standard bundles, tagged and marked in accordance with the Code of Standard Practice of the Concrete Reinforcing Steel Institute.

The dimensions of hooks and the diameters of bends measured on the inside of the bar shall be as shown on the Plans. When the dimensions of hooks or the diameter of bends are not shown, they shall be in accordance with Division I, Article 8.23 or ACI 318, "Building Code Requirements for Reinforced Concrete."

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.

b. Uncoated Bars. All reinforcement bar, wire, or fabric when unloaded at the bridge site shall be stored above the ground on sills, blocking, or other supports and shall be protected as far as practicable from mechanical injury or corrosion causing conditions. All material must be kept free from harmful rust by proper weather protection until installed.

Rusted areas must be thoroughly wire brushed just prior to installation as directed by the Engineer.

c. Coated Bars. In addition to the above requirements for uncoated bars, the following special conditions will apply for coated bars.

1. Handling and Storage of Coated Bars. All systems for handling coated 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 strong back, 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.

The costs for extra handling precautions are expected to be offset by elimination of major touch up repair by the fabricator, the Contractor and the shippers.

810.03.4 Placing and Fastening.

a. Uncoated Bars.

1. General. 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. The clear distance between parallel bars (except in columns and between multiple layers of bars in beams) shall be not less than the nominal size of the coarse aggregate, or 1 inch, whichever is greater.

Where reinforcement in beams or girders is placed in two or more layers, the clear distance between layers shall be not less than 1 inch, and the bars in the upper layers shall be placed directly above those in the bottom layer.

In spirally reinforced and tied columns, the clear distance between longitudinal bars shall be not less than 1½ times the bar diameter, 1½ times the maximum size of the coarse aggregate, or 1½-inches, whichever is greater.

The clear distance between bars shall also apply to the clear distance between a contact splice and adjacent splices or bars.

The maximum spacing of bars carrying calculated stress shall be 1½ times the thickness of slab or wall. The maximum spacing of bars for temperature reinforcement shall be 18 inches.

3. Cover. All reinforcing bars shall have the following cover:

	Location	Minimum Cover
(a)	Concrete cast against or permanently exposed to earth (footings, abutment and wall faces, backwalls, etc.):	3 inches
(b)	Stirrups, ties and spirals:	1½ inches
(c)	Slabs:	
	Without wearing surface: top;	2½ inches (+1/4", -0")
	bottom;	1 inch (+1/8", -0")
	With wearing surface: top;	2 inches (+1/4", -0")
	bottom;	1 inch (+1/8", -0")
(d)	All other bars:	2 inches
(e)	Work exposed to sea water:	4 inches

4. 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 will not be permitted. If required, precast concrete blocks placed with the small face down may be used.

5. Fastening. Bars shall be securely tied with wire at all intersections except where spacing is less than 1 foot in each direction, in which case alternate intersections may be tied. Welding of crossbars shall not be permitted unless specifically authorized.

All wire ties and miscellaneous hardware used for placement of epoxy coated reinforcing shall also be either epoxy or plastic coated, or have plastic tips protecting the ends which may rest against formwork.

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

6. 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, will not be permitted without the written approval of the Engineer. Splices shall be staggered as far as possible.

Lapped splices shall not be used for bar sizes larger than #11.

Unless otherwise shown on the Plans all reinforcing shall be lapped according to the following table. Lengths in parentheses are for epoxy coated reinforcement.

	Class of Concrete	
Bar Size	**(AE)**	**XX(AE)**
4	12"(12")	12"(12")
5	12"(12")	12"(12")
6	12"(14")	14"(16")

The laps listed above are for non-critical splices. All critical splices are detailed on the Plans.

In deck slabs: Top bars shall be spliced at center of spans between girders. Bottom bars shall be spliced over girders.

Mechanical devices for splicing bars shall be equivalent in strength to an approved welded splice and must be approved by the Engineer.

b. Welds. Welds will not be permitted unless indicated on the Plans or authorized by the Engineer. Where welding is indicated it shall conform to the applicable requirements of AWS D1.4, Structural Welding Code, Reinforcing Steel.

c. 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 fabric reinforcement shall overlap each other not less than one mesh in length or width, plus 2 inches.

d. Coated Bars. In addition to the applicable provisions of **Para. a**, above, the following special conditions will apply for coated bars.

1. Referenced Specifications. The provision of epoxy-coated bar reinforcement shall conform to the requirements of AASHTO Interim Material Specification M-284-811 and ASTM A775-81, or current revisions thereof.

2. Utilization.

(a) Superstructures. The top and bottom mats of cast-in-place bridge decks and sidewalks shall be epoxy coated. Also, all sidewalk bars and sidewalk dowels placed into the deck pour, and all parapet and jersey barrier reinforcement shall be epoxy coated.

(b) Substructures. Reinforcement in abutment backwalls and beam seats, end posts, and front faces (including the reinforcement anchored into the footings) shall be epoxy coated.

Pier columns and caps shall have epoxy coated bars if they are under an expansion deck joint; within 30 feet from the edge of the adjacent roadway (50 feet on freeways); or have superstructures without parapets to contain roadway salts from above.

Abutment wingwalls shall have epoxy coated bars on the front face (including the reinforcement anchored into the footings) if they are within 30 feet from the edge of the adjacent roadway (50 feet on freeways).

3. Field Bending. No field bending will be permitted unless otherwise indicated on the Plans. Where field bending is allowed, repairs to damaged epoxy coatings shall be made in accordance with applicable subsections of this Section.

4. Splices. Splices shall be permitted only where shown on the Plans. Splices shall be made by placing the bars in contact and wiring them together for the full length of the splice with plastic-coated tie wire.

5. Placement. Prior to placing epoxy coated reinforcing steel, all grease, dirt, mortar, and any other foreign substance must be removed from the bars.

The reinforcement shall be placed in the position indicated by plastic or plastic-coated wire supports, and within the allowable tolerances specified. Before concrete is placed, all reinforcement shall be securely fastened and supported with approved plastic or plastic-coated metal chairs or other approved devices.

Concrete shall not be placed until the reinforcing steel is inspected and permission for placing concrete is granted by the Engineer. All concrete placed in violation of this provision shall be rejected and removed.

6. Repair of Epoxy Coating. Coating repair will not be required if damage is less than 3 percent of the coated area. Where repair is required, all damaged areas will be repaired as soon as possible after each span is placed. Repairs shall be made in accordance with the manufacturer's recommendations and to the prescribed thickness.

7. Test Bars. Extra bars for field sampling shall be furnished in accordance with **Subsection 810.03.2**, above.

810.03.5 Drill and Grout Reinforcing Dowels. Provisions for drilling and grouting dowels are set forth in **SECTION 819** of these Specifications.

810.04 METHOD OF MEASUREMENT.

810.04.1 Bar Reinforcement and Spiral Wire. "Bar Reinforcement" and "Spiral Wire", both plain and deformed and coated 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 tables of Division II of the AASHTO Standard Specifications for Highway Bridges. 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 epoxy coating in computing the weight of epoxy coated bar reinforcement. Epoxy coating for bar reinforcement will not be measured separately for payment.

810.04.2 Wire Fabric Reinforcement. "Welded Wire Fabric Reinforcement," coated 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. Epoxy coating for 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, and equipment, and all other 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, and

equipment, and all other incidentals required to finish the work, complete and accepted by the Engineer.

SECTION 811

WEEP HOLES, PAVEMENT SUBDRAINS AND WALL DRAINS

811.01 DESCRIPTION. This work consists of the provision of weep holes through abutments and walls; pavement subdrains through bridge decks; and wall drains behind abutments and walls, at the locations indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

811.02 MATERIALS.

811.02.1 Weep Holes. Unless otherwise specified, weep holes shall be 4 inches in diameter, Schedule 40 polyvinylchloride (PVC) pipe.

811.02.2 Pavement Subdrains. Unless otherwise specified in the Special Provisions, pavement subdrains shall be either 2-inch diameter PVC pipe or 2-inch diameter ductile iron pipe. Ductile iron pipe shall conform to the requirements of **Subsection M.04.02.1** of these Specifications.

811.02.3 Wall Drains. Unless otherwise specified in the Special Provisions, wall drains shall be perforated bituminous coated corrugated metal pipe conforming to the requirements of **Subsection M.04.02.5.**

811.02.4 Filter Stone shall conform to the requirements of **Subsection M.01.07.**

811.02.5 Filter Fabric shall be one of those materials included in the Department's Approved Materials List.

811.03 CONSTRUCTION METHODS.

811.03.1 Weep Holes. In order to drain backfill material, weep holes shall be placed through abutments and retaining walls at those locations indicated on the Plans. Unless connected to wall drains, dry wells consisting of a total of 5-to-6 cubic feet of filter stone shall be constructed at the inlet end of all weep holes to act as filter pockets. Filter stone shall be encased in burlap or woven plastic filter fabric. A filter fabric screen shall be cemented to the back face of the wall prior to placement of the filter stone bags. The filter fabric screen shall extend past the filter stone bag perimeter by at least 1 foot.

The outlet end of weep hole pipe shall extend 1 inch beyond the surface of the concrete to form a drip element. Pipes shall be sloped downward toward the face of the wall or abutment at 1/4-inch per foot. Pipes shall be located 6 inches above finished grade and shall be spaced at 10-foot on centers.

811.03.2 Pavement Subdrains. The subdrains shall be constructed to the dimensions indicated on the Plans. They shall be placed along the face of curbs at the locations indicated on the Plans or as directed by the Engineer.

Pavement subdrains shall be installed after the waterproofing membrane has been placed and before the bituminous course is laid down. The waterproofing membrane shall be cut with a sharp blade so that tabs can be folded into the drain hole. The drain cap can then be installed in the drain hole. Care shall be exercised to prevent displacement of the drain cap as the bituminous courses are placed.

811.03.3 Wall Drains. The pipe shall be laid to the lines and grades indicated on the Plans or as directed by the Engineer. Pipe shall be placed on well compacted backfill materials. The perforated side of the pipe shall be placed down.

Filter material shall be placed around the pipe to form a cover of not less than 6 inches unless otherwise directed by the Engineer. The filter material shall be carefully tamped around the pipe.

811.04 METHOD OF MEASUREMENT.

811.04.1 Weep Holes and Pavement Subdrains. Unless covered by a Special Provision, together with a corresponding Proposal Item, weep holes and pavement subdrains will not be measured separately for payment.

811.04.2 Wall Drains. "Wall Drains" will be measured by the number of linear feet actually installed in accordance with the Plans and/or as directed by the Engineer.

811.05 BASIS OF PAYMENT.

811.05.1 Weep Holes and Pavement Subdrains. Unless covered by a specific Proposal Item, materials for the installation of weep holes and pavement subdrains will not be paid for separately, but will be included as incidental items in the respective contract unit prices per cubic yard as listed in the Proposal for the applicable classes of Portland cement concrete.

811.05.2 Wall Drains. The accepted quantity of "Wall Drains" will be paid for at the contract unit price per linear foot as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, and equipment, including fittings and filter stone, filter fabric, and all other incidentals required to finish the work, complete and accepted by the Engineer.

SECTION 812

WATER STOPS AND FLASHINGS

812.01 DESCRIPTION. This work consists of the provision of water stops and flashings placed 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.

812.02.1 Lead Coated Copper. Lead coated copper flashings and/or waterstops shall be cold rolled, hard temper, lead coated copper, with lead coating both sides, conforming to the requirements of ASTM B101.

812.02.2 Lead. Sheet lead flashings and/or waterstops shall be desilverized pig lead conforming to the requirements of ASTM B29.

812.02.3 Rubber Waterstops. Rubber waterstops and fittings shall be high quality, vulcanized elastomeric neoprene conforming to the requirements of Army Corps of Engineers Specification CRD-C-513.74.

812.02.4 Polyvinylchloride Waterstops. Polyvinylchloride waterstops and fittings shall be manufactured from virgin polyvinylchloride plastic compound and shall not contain any scrap or reclaimed material. The material shall be produced by an extrusion process and shall be dense, homogeneous, and free from holes and other imperfections.

812.03 CONSTRUCTION METHODS.

812.03.1 Flashings. Copper or lead flashings, fabricated as described, shall be installed as shown on the Plans, or as directed by the Engineer. In general, flashing shall be used at expansion-contraction joints and at contraction joints. Unless otherwise specified, the fabricated material shall be delivered in lengths convenient for handling, and when necessary to splice adjacent sections, copper flashing shall be lapped as shingles for about two inches and tightly soldered, lead flashing shall be fused together in accordance with the best lead burning practice, each to form a complete watertight joint. Bends shall be carefully formed to maintain the continuity of the section. Flashing shall be placed in such a manner as to insure its embedment in the concrete on each side of the joints in the exact positions shown on the Plans.

When flashing is used to form caps over expansion-contraction joints and the edges are to be set into grooves in the concrete parallel to the joints, these grooves and other voids in the assembly shall be filled with a bituminous compound conforming to the requirements of **Subsection M.02.11.2; Joint Seal**.

812.03.2 Waterstops. Adequate waterstops of metal, rubber or polyvinylchloride 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 continuous watertight joints.

a. Rubber Waterstops. Rubber waterstops shall have a minimum tensile stress of 2,500 psi and a Type Shore A Durometer hardness reading between 50 and 60. The waterstops shall be formed with an integral cross section and shall be manufactured in accordance with the highest industry standards and installed in accordance with the manufacturer's recommendations.

b. Polyvinylchloride Waterstops. A manufacturer requesting approval of a waterstop shall furnish to the Engineer a 3-foot length of each type of waterstop he intends to supply. A Certificate of Analysis from an approved independent testing laboratory shall be furnished with the samples. 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.

c. Installation of Waterstops. The Engineer shall require that the Contractor 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 shall be found defective (because of improper installation) at any time before the final acceptance, the Contractor shall, at his own expense, make good such defect to the satisfaction of the Engineer.

1. Preparatory Work. All waterstops should be protected from oil, dirt, concrete spatter and damage and should be left clean to receive concrete forms. Particular care should be taken during installation of waterstops to eliminate all possibilities that may cause leakage. Reinforcing bars and slip dowels shall not interfere with positioning of waterstops during installation.

2. Methods. Different methods may be used to fasten the waterstop in position. All waterstops should be held rigidly in place by extending through slots in keyways; held by split bulkheads; tied to reinforcing bars; or other adequate methods as are dictated to insure proper support and embedment during the concreting process.

3. Splicing. PVC waterstops may be butt-spliced on the job, with an electrical splicing iron. There is no crimping, shaping, brazing, or vulcanizing necessary. Upon request the manufacturer will illustrate the splicing method for producing a strong, water-tight butt weld. Elbows, tees and crosses can also be produced by this method.

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

812.05 BASIS OF PAYMENT. Unless covered by a specific Proposal Item, waterstops and flashings will not be paid for separately, but will be included as incidental items in the respective contract unit prices per cubic yard as listed in the Proposal for the applicable classes of Portland cement concrete.

SECTION 813

WATERPROOFING AND DAMPPROOFING

813.01 DESCRIPTION. This work consists of providing dampproofing and waterproofing systems on concrete bridge decks and other surfaces at the locations indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

813.01.1 Systems.

a. Dampproofing shall consist of mopped applications of approved bituminous materials.

b. Waterproofing shall consist of the application of a preformed membrane; a rubberized liquid asphalt membrane, or a cold applied liquid membrane, all as set forth below.

813.01.2 Dampproofing. This type of dampproofing consists of a prime coat and two mopped applications of an approved bituminous material.

813.01.3 Preformed Waterproofing Membrane. This type of waterproofing system consists of applying a preformed bituminous membrane of approved manufacture to concrete surfaces in strict compliance with the manufacturer's recommendations.

813.01.4 Rubberized Liquid Asphalt Membrane. This type of waterproofing system consists of applying a hot, liquid asphalt membrane of approved manufacture to concrete surfaces in strict compliance with the manufacturer's recommendations.

813.01.5 Cold Applied Liquid Membrane. This type of waterproofing system consists of applying an acrylic resin based elastomeric membrane of approved manufacture to concrete surfaces in strict compliance with the manufacturer's recommendations.

813.02 MATERIALS.

813.02.1 General. Materials for dampproofing and waterproofing systems shall be delivered in original, tightly sealed containers or unopened packages, clearly labeled with manufacturer's name, brand name and number, and batch number of the material where appropriate.

Prior to delivery, the manufacturer shall submit to the Engineer a notarized certificate attesting that the material conforms to these Specifications in every respect.

813.02.2 Dampproofing.

a. Prime Coat. The prime coat shall conform to the requirements of **Subsection M.12.01.1** of these Specifications.

b. Mop Coats. The mop coats shall conform to the requirements of **Subsection M.12.01.2** of these Specifications.

813.02.3 Preformed Waterproofing Membrane. The primer and sheet membrane materials of this system shall conform to the respective requirements of **Subsection M.12.02.2** of these Specifications.

813.02.4 Rubberized Liquid Asphalt Membrane. The surface conditioner, membrane, and protective sheet materials of this system shall conform to the respective requirements of **Subsection M.12.02.1** of these Specifications.

813.02.5 Cold Applied Liquid Membrane. The primer and membrane materials of this system shall conform to the respective requirements of **Subsection M.12.02.3** of these Specifications.

813.03 CONSTRUCTION METHODS.

813.03.1 Surface Preparation for All Types. New concrete shall have cured a minimum of 7 days in accordance with ACI-308. New or existing surfaces shall be free of oil, grease, curing compounds, algae, moss, laitance, friable matter, bituminous products and previous waterproofing membranes. If required, degreasing shall be performed with detergent washing in accordance with ASTM D4258. Concrete surfaces shall be abrasively cleaned in accordance with ASTM D4258 and all spalls repaired with concrete patch materials per the Engineer's and Manufacturer's recommendations. Voids and blowholes on vertical surfaces shall be repaired in the same manner.

Areas of minor surface deterioration or depression of 0.5-inch and greater in depth shall be brought to grade with an approved patching mortar. Cracks and joints shall be treated in accordance with the manufacturer's recommendations as approved or directed by the Engineer.

The applicator shall be responsible for the protection of equipment and adjacent areas from overspray or other contamination that may be caused by application of the dampproofing or waterproofing.

813.03.2 Dampproofing.

a. Limitations. No dampproofing shall be applied in wet weather, nor when the temperature is below 35°F without special authorization from the Engineer. Should the surface of the concrete become temporarily damp, it shall be covered with a 2-inch layer of hot sand, which shall be allowed to remain in place long enough to produce a warm and dry condition. The sand shall be swept back, uncovering sufficient area for commencing work. The operation may be repeated as the work progresses.

b. Prime Coat. Immediately after the surface is prepared and in order to insure a proper bond between the dampproofing material and the concrete, a prime coat shall be applied. The primer shall be sprayed or brushed on the surface at a rate of approximately 1/10 of a gallon per square yard so as to cover it completely and uniformly. The quality of the primer and the method of application shall be approved by the Engineer.

c. Application. Concrete or other surfaces which are to be protected by dampproofing shall be mopped or brushed with two coats of an approved bituminous material for absorptive treatment.

The bituminous material shall be heated to a temperature between 300°F and 350°F. The material will be stirred frequently to avoid localized overheating. The heating kettle shall be equipped with thermometers.

The bituminous material shall be applied with suitable mops or brushes. Each coat shall be mopped over the surface, completely covering same with a continuous heavy film. When any breaks or thin spots show in the dampproofed surface after drying, they shall be retouched to secure an even impervious coating.

The interval between successive applications shall not be less than 18 hours.

The completed dampproofing shall be protected by the Contractor from damage by subsequent construction operations.

813.03.3 Preformed Waterproofing Membrane. Concrete surfaces that are to receive this type of waterproofing shall have a wood float or trowelled finish.

a. Manufacturer's Representative. The Contractor shall furnish the services of a competent field representative of the approved manufacturer to be present at the work site prior to any use of materials. The representative shall instruct the Contractor and the Engineer on installation and inspection procedures and to inspect the condition of the prepared surfaces. The representative will remain on the job site until the completion of the work.

b. Application. The prime coat is to be applied only to areas that will be covered with membrane within the following 24 hours. Any areas not covered within 24 hours must be re-primed. The primer material and rate of coverage shall meet the specifications of the manufacturer. The primer shall be allowed to dry one hour or until tack free before placing the membrane. The membrane shall not be applied at temperatures below 40°F.

All corners such as at curbs shall be double covered by using an initial strip of 12-inch minimum width, placed along the axis of the corner. Inside corners should be finished with a fillet, and outside corners should be rounded. Areas around drains or other protrusions should be double covered with the membrane for a minimum of 6 inches in each direction, then liberally coated with an approved mastic.

The membrane should be laid from the low point to the high point with the membrane overlapped a minimum of 4 inches. Misaligned or inadequately lapped seams must be repaired.

The wearing surface should be placed as soon as possible after application of the membrane. A careful inspection must be made before covering the membrane, and any tears or holes must be repaired with necessary patches.

813.03.4 Rubberized Liquid Asphalt Membrane.

a. Manufacturer's Representative. The requirements for the Manufacturer's Representative are the same as set forth above in **Para. a** of **Subsection 813.03.3.**

b. Sample Area. At the option of the Engineer, the Contractor shall apply the liquid membrane on a sample area not less than 10 square feet in size. When approved, the sample area shall serve as a standard of acceptance for all membrane work.

c. Mixing. All mixing and application of the liquid membrane system shall be done in strict accordance with the printed instructions of the approved manufacturer and as directed by the Engineer. The Contractor shall submit to the Engineer, when requested, evidence indicating that the proposed membrane applicator subcontractor is fully qualified to perform the work, and any proposed subcontractor found not qualified shall, at the written request of the Engineer, be removed forthwith by the Contractor.

d. Application. The surface conditioner shall be applied evenly, using a low pressure sprayer, to all surfaces at a rate not exceeding one gallon per 300 square feet or not less than one gallon per 600 square feet, depending on the concrete surface. The conditioner shall be allowed to dry before application of the membrane.

Cakes of membrane shall be melted in an approved double shell melter under continuous agitation until the material can be drawn free-flowing and lump-free at a temperature not exceeding 425°F.

Membrane shall be applied evenly at the rate of one pound per square foot to provide a continuous coating not less than 1/8-inch thick and averaging 3/16-inch thick.

The areas to be waterproofed shall be inspected during application of the liquid membrane system by the Engineer to insure that the membrane thickness is in accordance with the paragraph directly above. Any deficiencies shall be repaired at the expense of the Contractor.

e. Protection. Immediately following application of the membrane, and before it cools and before vehicular or foot traffic is allowed on the membrane, the entire waterproofed bridge deck shall be covered with rolled asphalt sheets.

Protective sheets shall be laid parallel to the center line of the bridge roadway unless otherwise approved by the Engineer. The protective sheets should not be allowed to overlap at either the longitudinal or transverse joints. The joint should be a tight butt type. The maximum allowable space between sheets is 1/4-inch. The entire application of protective sheets shall be free of wrinkles, bubbles, fishmouths or other defects.

Following placement of the protective sheet, a bead of hot membrane shall be placed along the joint where the sheet terminates at the face of the curb. The bead shall be continuous to prevent water from entering between the protective sheet and membrane.

f. Testing. During the waterproofing work, field samples of the membrane material may be taken for evaluation by the Engineer. Tests shall include penetration, flow, low temperature flexibility and adhesion and elasticity, all as specified herein.

813.03.5 Cold Applied Liquid Membrane.

a. Manufacturer's Representative. The requirements for the manufacturer's representative are the same as set forth above in **Para. a** of **Subsection 813.03.3**.

b. Surface Preparation. In addition to the requirements of **Subsection 813.03.1**, all steel surfaces shall be prepared to a near white metal finish per SSPC-10 and overcoated with primer within 4 hours.

c. Testing. Random tests for adequate tensile bond strength shall be conducted on the substrate by the applicator on site using an Elcometer Adhesion Tester Model 106 or similar at a minimum frequency of three tests per 5,000 square feet. Smaller areas shall receive a minimum of three tests. Should the tensile bond strengths be lower than 100 psi on concrete (or failure within the concrete) or 290 psi on steel, the Engineer may request further surface preparation.

d. Application. Application can proceed while air and substrate temperature are between 32°F and 104°F providing the substrate is above the dew point. Outside these temperatures the manufacturer shall be consulted. All components of the system shall be measured and mixed strictly in accordance with the manufacturer's recommendations. Mixing shall be done with either an air driven high speed paddle or an explosion proof mixer. Prior to the application of any

materials, the surface must be clean and free from loose debris, moisture, oil, grease or other contaminates.

1. Primer. A single coat of spray, roller or brush applied primer is required for all steel and concrete surfaces. This primer shall cure tack free before application of the waterproofing membrane.

2. Membrane. The waterproofing membrane shall be spray applied with suitable equipment, approved by the manufacturer, in two color differentiated coats, each with a wet film thickness of 60 mils per coat providing a finished minimum thickness of 80 mils on any peak. Checks for wet film thickness shall be carried out typically every 100 square feet. The membrane shall cure between coats and before application of the tack coat.

3. Tack Coat. A tack coat, supplied by the same manufacturer, shall be applied directly to the waterproofing membrane prior to surfacing.

e. Repairs.

1. Patching. If an area is left untreated or the membrane becomes damaged, a patch repair shall be carried out to restore the integrity of the system. The damaged area shall be cut back to sound material and wiped with solvent (e.g., acetone) up to a width of at least 4 inches on the periphery, removing tack coat and any contaminants. The substrate shall be primed, if necessary, followed by the application of membrane. A continuous layer shall be obtained over the substrate with a 4-inch overlap onto the existing membrane.

2. Overlapping. Where the membrane is to be joined to existing cured material and at day joints, the new application shall overlap the existing one by at least 4 inches. No preparation shall be necessary unless the existing materials are contaminated with tack coat or dirt in which case the repair/overlap area shall first be wiped with solvent (e.g., acetone).

f. Protection. During all stages of application, the membrane shall be protected by the Contractor from damage by construction operations.

g. Final Review. The Engineer and the applicator shall jointly review the deck area(s) in which the completed system has been installed, prior to surfacing. Any irregularities or other items which do not meet the requirements of the Engineer shall be addressed at this time.

813.04 METHOD OF MEASUREMENT. "Dampproofing," "Preformed Waterproofing Membrane," "Rubberized Liquid Asphalt Membrane," and "Cold Applied Liquid Membrane," all will be measured by the number of square yards of each system actually placed in accordance with the Plans and/or as directed by the Engineer.

813.05 BASIS OF PAYMENT. The accepted quantities of "Dampproofing," "Preformed Waterproofing Membrane," "Rubberized Liquid Asphalt Membrane," and "Cold Applied Liquid Membrane," will be paid for at their respective contract unit prices per square yard as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, materials, and equipment and all other incidentals required to finish the work, complete and accepted by the Engineer.

SECTION 814

PLACEMENT OF CONCRETE BRIDGE DECKS

814.01 DESCRIPTION. This work consists of the placement of concrete bridge decks by using self-propelled finishing machines, all as indicated on the Plans and in accordance with these Specifications.

814.02 MATERIALS. Materials for all Portland cement concrete mixes shall conform to the requirements of **SECTION M.02; PORTLAND CEMENT CONCRETE**, of these Specifications.

814.03 CONSTRUCTION METHODS.

814.03.1 General. All equipment, tools, and requirements pertaining to the classification, proportioning, and testing for the specified class of concrete, including batching, mixing, handling, placing, curing and finishing shall conform to the applicable requirements of **SECTIONS 601, 808 and 816**, respectively, of these Specifications, and as modified in this Section.

814.03.2 Contractor's Plan. At least 30 calendar days prior to the proposed start of placing the concrete bridge deck, the Contractor shall submit to the Engineer for approval, a submission (herein called the Placement and Curing Plan) specifying the method of concrete conveyance, placement, type and number of finishing machines, rate of pour, estimated time of completion, screed and rail erection plan, sequence of concrete pours, and the concrete curing procedure. The Placement and Curing Plan shall take into consideration weather conditions. It shall also include details and a complete description of equipment to be used in the handling, placement, finishing and curing the concrete including the number and type of personnel who will be engaged in the operation. The personnel shall consist exclusively of persons with the experience and skill appropriate to their working assignment. Approval of this plan will not relieve the Contractor of the responsibility for the satisfactory performance of his methods and equipment. All other approval requirements shall be as set forth in this Section.

a. Other Arrangements. Elevations for setting forms and screed supports shall be based on an accurate set of computations run by the Contractor and shall be located no more than 10 feet apart. Before placing the concrete, the Contractor shall make all necessary arrangements and have all materials on hand for curing and protecting the concrete deck. Concrete placement shall not proceed until the Engineer is satisfied that all necessary steps have been taken to insure adequate compliance with these Specifications and that completion of the operation can be accomplished within the required scheduled time. It shall be the Contractor's responsibility to allow sufficient time to permit such an inspection by the Engineer.

814.03.3 Limitation of Mixing.

a. Temperature and Weather Conditions. All weather and concrete temperature requirements shall meet the requirements of **Subsection 601.03.4** except as modified herein.

No bridge deck concrete shall be placed when the relative humidity is below 35 percent. When placing concrete, the Contractor must provide suitable equipment and take appropriate actions as approved by the Engineer to limit the evaporation rate of the exposed concrete surface to less than 0.15 $lb/ft^2/hr$. The evaporation rate shall be determined in accordance with Table 1 of this Specification. To maintain the evaporation rate below the specified limit the Contractor shall take one or more of the following actions:

1. Misting the surface of the concrete with a triple head nozzle immediately behind the finishing machine and until the curing cover is applied. The nozzle shall be rated at one gallon per minute or less and shall produce a fine, fog mist which will maintain a sheen of moisture on the concrete surface without ponding.

2. Construct windbreaks or enclosures to effectively reduce the wind velocity throughout the area of placement.

3. Reduce the temperature of the concrete.

b. Hot Weather Concrete. During hot weather conditions, the concrete temperature at time of placement shall conform to the requirements of **Subsection 601.03.6** of these Specifications.

c. Cold Weather Concrete. During cold weather conditions, the concrete temperature at the time of placement shall conform to the requirements of **Subsection 601.03.5** of these Specifications.

d. Inclement Weather. When rain or snow is imminent, all new concrete shall be adequately protected to prevent damage which may result in surface imperfection of the deck. Sufficient polyethylene coverings conforming to the requirements of **Subsection M.02.04.2** shall be available at the site of the work for possible immediate use.

814.03.4 Handling.

a. General. Prior to concrete placement all forms must be clean, free of rust, excessive oils, and any foreign debris. All concrete forms and materials such as shear connectors, dams, ductwork, spacers, rebars, and any other materials as required in the contract drawings must be inspected and approved by the Engineer before concreting operations commence.

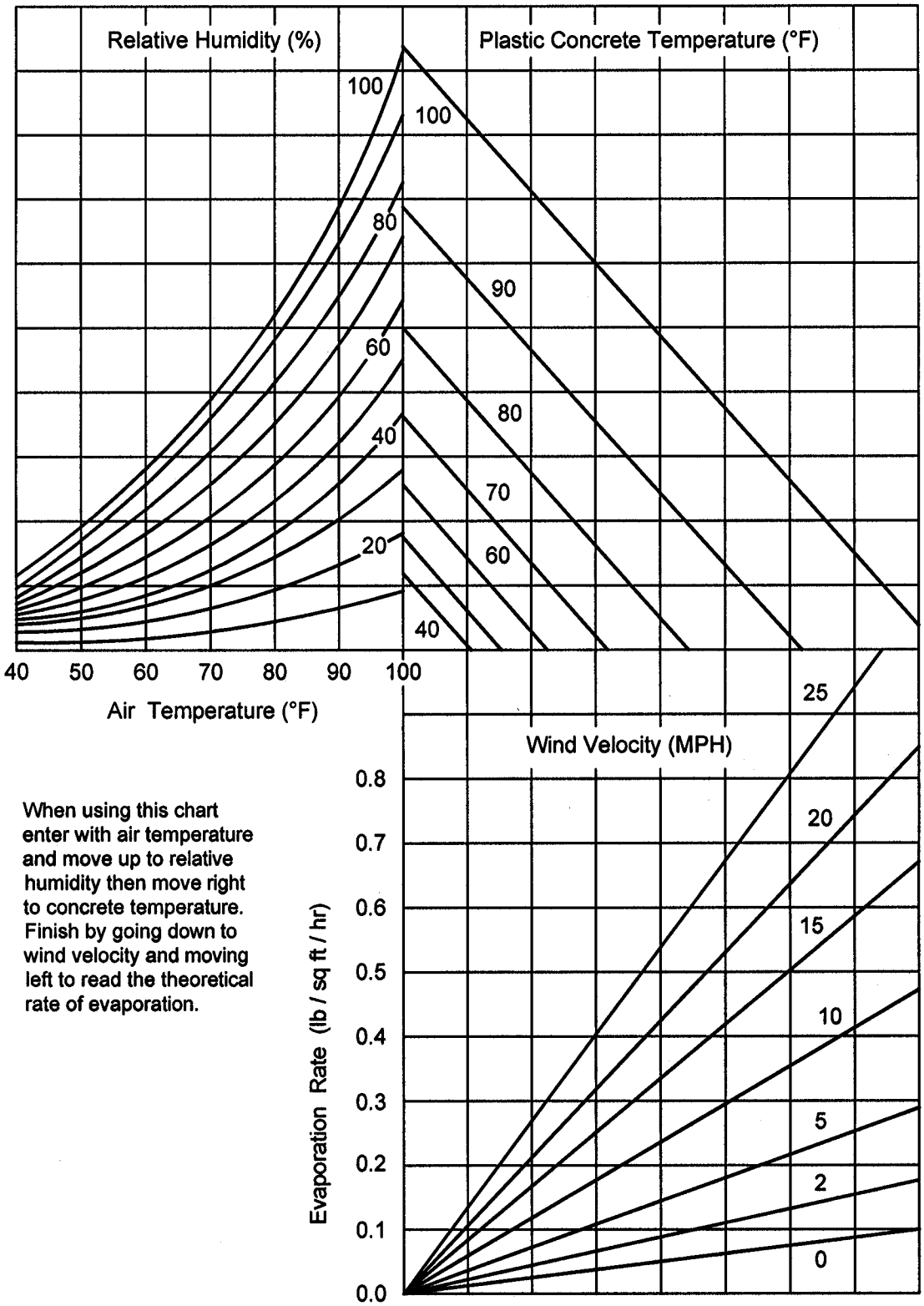
In no case shall welding of forming attachments, or other construction aids, to tension flanges be permitted. Tension areas shall be as specified on the contract drawings.

Concrete shall be placed continuously without interruption between planned construction or expansion joints.

814.03.5 Concrete Placement Sequence.

a. Simple Spans. Concrete bridge deck placement shall progress continuously over the entire width and for the full length of the bridge. Deck placement shall begin at the expansion end of the span and terminate at the fixed end. Transverse construction joints are not permitted unless otherwise shown on the contract drawings or with the approval of the Engineer.

Table #1



When using this chart enter with air temperature and move up to relative humidity then move right to concrete temperature. Finish by going down to wind velocity and moving left to read the theoretical rate of evaporation.

b. Continuous Spans Where Transverse Construction Joints are not Specified. The deck placement sequence and direction of pour shall be as shown on the contract drawings. In general, deck placement shall begin at the outside supports and at the midpoint between interior supports, and shall progress towards the interior supports. Deck placement shall be uniform and continuous over the full width of the superstructure.

c. Continuous Spans Where Transverse Construction Joints are Specified. The number and location of transverse construction joints shall be as specified on the contract drawings and as approved on the proposed Placement Plan. All concrete between consecutive joints shall be placed in a continuous operation as shown on the contract drawings. The first pour shall include the positive moment area in all spans. The second pour shall include the negative moment area and shall not be placed until a minimum of 72 hours have elapsed from the start of the first pour. The limits of the positive and negative moment areas are as defined and shown on the contract drawings.

814.03.6 Placement. Except as modified herein, concrete placement shall conform to the requirements of **Subsections 808.03.5** and **808.03.6; Placing Concrete (Conventional)** and **Placing Concrete by Pumping**, respectively, of these Specifications. It shall be the responsibility of the Contractor to attain a rate of placement such that the concrete is finished before the beginning of initial set. A minimum rate of placement of 35 cy/hr shall be maintained at each finishing machine.

Concrete placement shall take place during daylight and shall not begin unless the Contractor is certain that the placement can be completed and finished, to the satisfaction of the Engineer, during daylight hours. The Engineer may waive this requirement if adequate and approved lighting facilities are provided by the Contractor prior to the start of the deck placement. Before concrete placing operations begin, substantial bulkheads or headers shall be shaped to the required deck surface cross-section. In the event of unforeseen circumstances should the concrete placement be forced to cease, sufficient bulkheads shall be installed at locations determined by the Engineer and placing of concrete shall be discontinued. All concrete in place beyond the bulkhead shall be removed. Concrete placement will recommence only with the approval of the Engineer. Unless otherwise specified, the concrete shall be placed as a monolithic unit in a continuous operation between joints.

a. Consolidation. The concrete shall be consolidated by means of an approved high frequency internal vibrator which shall be applied in a manner to secure maximum consolidation of the concrete. Consolidation shall leave the concrete free from voids and insure a dense surface texture, but not be continued so long as to cause segregation or bleeding. A small uniform quantity of concrete shall be maintained ahead of the screed on each pass. At no time shall the quantity of concrete carried ahead of the screed be so great as to cause slipping or lifting.

In the case where the vibratory action of the finishing machine does not provide consolidation in accordance with the rate of placement, the Contractor shall have in reserve at all times sufficient vibration equipment to guard against shutdown of the work. The Contractor shall take preventive measures to insure that the epoxy coated reinforcement is not susceptible to damage by the vibrators.

814.03.7 Finishing. Methods, procedures, and equipment shall be used which will insure a uniform riding surface without over-vibration or segregation of the components of the concrete.

The leading edge of freshly placed concrete shall at all times be maintained approximately parallel to the finishing machine.

Self-propelled finishing machines will be required unless specifically noted otherwise on the Plans or in the Special Provisions.

a. Finishing Machine. An approved self-propelled finishing machine(s) will be required for consolidating, striking off and finishing the concrete deck surface. The finishing machine(s) shall be of sufficient width to finish the full width of the deck. The weight of the finishing machine(s) shall not cause unaccounted for deflection of the bridge members or falsework. The machine shall travel on steel rails, pipe or other approved grade control, which shall be supported by vertical supports securely fastened in place at a maximum spacing of 2 feet to prevent any appreciable deflection between rail supports. Prior to placing the concrete, screed rails shall be completely in place, and accurately set to insure finishing of the concrete deck surface to the elevations shown on the Plans. The supports for the rails, if embedded in the deck concrete, shall be of the type which can be removed without disturbing the concrete. Screed rails shall not be treated with parting compound to facilitate their removal. Rails for finishing machines shall extend beyond both ends of the scheduled length for concrete placement. The extended length shall be of sufficient distance to allow finishing machine(s) to clear the concrete to be placed.

The finishing machine shall be capable of propelling itself both forward and backward to enable repeated passes to be made in order to correct surface irregularities and to produce a surface which conforms to the required profile grade, cross-section and surface smoothness. A maximum of two passes of the machine will be allowed over any given deck area.

The finishing machine(s) shall be operated over the full length of the bridge segment to be finished prior to beginning of concreting operations. The test run shall be made with screed adjusted to its finishing position. During the test run, checks shall be made of the deflection due to the finishing machine, adjustment of guide rails and required covers for slab reinforcement. The required concrete cover over the top bars shall be checked by riding the screed over the bars and measuring the cover over the slab reinforcement. Discrepancies so found, which are in excess of the tolerances given on the Plans, shall be rectified to secure the required concrete cover. All necessary corrections shall be made before concreting is begun.

Concrete placement and initial strike-off shall be coordinated so that initial strike-off is never more than 10 feet behind the concrete placement. Sufficient depth checks shall be made behind the machine(s) and along the full length of the span to insure achievement of the required section and reinforcement cover. The direction of placing the concrete shall be as specified on the Plans.

On skewed bridge decks, the placement of the concrete and the operation of the finishing machine should parallel the skew angle.

Improper adjustment or operation of the finishing machine which results in inadequate reinforcement cover or smoothness shall be corrected immediately. Unsatisfactory performance, particularly with respect to the surface smoothness attained, may be cause for rejection of the equipment.

b. Work Bridge. An adequate number of work bridges shall be provided by the Contractor in order to permit access to the surface of the deck for the purpose of finishing, straight-edging, making corrections, and setting curing materials. Workmen will not be permitted to walk in the fresh concrete after it has been screeded. All finishing work, including application of the fog spray and placement of curing mats, shall be performed from bridges supported above the deck surface.

c. Tolerances. Verification of the completed surface of the deck, in accordance with the grades and cross slope specified on the contract drawings, shall be made during placement and again after the deck has been cured. When the concrete is still plastic, the deck surface shall be tested with a ten-foot straight-edge and any variance in excess of 1/8-inch in 10 feet shall be corrected immediately. In the event that this tolerance is not met when tested after the concrete has hardened, variance in excess of 1/8-inch in 10 feet shall be corrected at the Contractor's expense in a manner satisfactory to the Engineer.

814.03.8 Curing. In the **Placement and Curing Plan**, the Contractor shall include the curing details for achieving the curing of the concrete as required by these Specifications.

a. Detailed Plan. The detailed plan shall include, but not be limited to, the following:

1. Curing method.

2. Provisions for enclosures, indicating method of holding down enclosure safely in place.

3. Heat devices, types and location around structure.

4. Method of monitoring temperature of hardened concrete.

5. Backup systems as required.

b. Curing Operations. Immediately following the finishing operation, the application of a water fog spray, shall begin and shall be applied continuously, rather than intermittently, until such time as moist covers are placed on the concrete surface. Fog spraying shall continue as required to provide a continuous supply of moisture to maintain a thoroughly moist concrete surface. As soon as concrete finishing operations are completed the Contractor shall promptly cover the newly placed concrete surface with a single layer of clean, heavy duty water saturated burlap conforming to the requirements of **Subsection M.02.04.1** of these Specifications. Burlap shall be free from cuts, tears, uneven weaving and contaminants. The burlap shall be placed such that the edges are lapped a minimum of 6 inches. A 4 mil clear or white polyethylene sheet conforming to **Subsection M.02.04.2** shall be placed over the saturated burlap cover.

White plastic coated fiber blankets conforming to the requirements of **Subsection M.02.04.2** may be used. Placement requirements must conform with the burlap edge lapping specification.

Unless otherwise approved by the Engineer, the application of curing compounds in lieu of fog spray and moist cure process shall not be allowed when membranes or overlays are specified.

All concrete shall be kept continuously moist and protected against any drying for a minimum period of 7 consecutive days after placement of concrete. The burlap covers shall be kept moist for the entire 7-day curing period, and under no circumstances shall the concrete be allowed to be exposed to an alternating wet and dry condition.

If at any time during the curing period the surface of the concrete deck is judged to be losing excessive moisture so as to adversely effect the curing process, the Engineer may require that the polyethylene sheets be removed and the coverings be saturated. The Contractor shall then recover the saturated coverings with polyethylene sheets.

In the event that forms or sections of forms have been loosened and/or removed in advance of the curing period, the exposed concrete surface shall be immediately covered with saturated curing covers and kept saturated for the remainder of the curing period.

c. Falling Temperatures. When the air temperature is expected to fall below 35°F, the Contractor shall provide suitable measures to maintain the concrete surface temperature between 50°F and 85°F which shall be monitored by a continuously recording thermometer. The minimum 50°F temperature requirement shall be continuously maintained around the forms and deposited concrete for the entire curing period of the first 7 days.

If the concrete surface temperature falls below 45°F during the first 7 days of the curing period, the structure shall be enclosed and external heat shall be provided as directed by the Engineer. If external heat is required, the following shall apply:

1. The time required for tenting shall not be counted as curing time.

2. External heat shall be maintained on the structure for the entire seven-day curing period and then reduced gradually such that the uniform change in temperature does not exceed 5°F in one hour or 50°F in any 24-hour period.

Removal of forms shall be as specified in **Subsection 808.03.10** of these Specifications.

If at any time during the curing period the concrete surface temperature falls below 35°F, the concrete may be considered as being unsatisfactory and rejected.

Adequate precautions shall be taken to protect the concrete deck from any damages resulting from severe weather conditions during the curing process.

a. Curing of Acceptance and Process Control Test Cylinders. All test cylinders will be field cured with the concrete deck under identical curing conditions.

814.03.9 Grooving. Unless otherwise shown on the Plans, the final finish required shall be as follows:

a. Bridge Decks with Exposed Concrete Surfaces. The final concrete surface shall be textured by transverse grooving. Transverse grooving shall not begin until the concrete has adequately met the curing and strength requirements listed under **Application of External Loads.** Grooving shall be done utilizing diamond blades, mounted on a multi-blade arbor on a self-propelled machine which has been built for grooving of pavements. The groover shall have a depth control device which will detect variations in the pavement surface and adjust the cutting

head height to maintain the depth of the groove specified. The grooving machine will be provided with devices to control alignment. Flailing type grooving which is uncontrolled and erratic will not be permitted. The Contractor shall provide an experienced technician to supervise the location alignment, layout, dimension, and grooving of the pavement.

Grooves shall be transverse (perpendicular) to the pavement centerline. Continuous, non-interrupted transverse grooving shall begin and end 2 feet from the curb lines.

Grooves shall be 1/4-inch deep with a tolerance of plus or minus 1/16-inch. The width of grooves shall be 1/8-inch. The spacing of grooves shall be 1½-inches with a tolerance of plus or minus 1/8-inch.

Grooves shall not be cut closer than 1 foot from any device cast or embedded into the deck surface, such as scupper castings, and deck joint materials or hardware.

At the beginning of each work shift, all machines shall be equipped with a full complement of grooving blades that are capable of cutting grooves of the specified width, depth and spacing.

The removal of all slurry or residue resulting from the grooving operation shall be continuous. Pavement must be immediately left in a washed, clean condition, free of all slipperiness from the slurry, etc. Residue from grooving operations should not be permitted to flow into gutters or other drainage facilities. Solid residue, resulting from grooving operations, should be removed from the pavement surfaces before such residue becomes airborne by the wind.

b. Bridge Decks with a Modified Structural Concrete Overlay. The initial concrete surface shall be screeded to the true cross section and left without any projections and/or the depressions that could retain water. Mixing, handling, placement finishing and curing of the modified structural concrete shall conform to the applicable requirements of **SECTION 815; LATEX MODIFIED CONCRETE FOR BRIDGE DECK OVERLAYS** and **SECTION 816; CONCRETE BRIDGE DECK OVERLAYS**, of these Specifications. However, pouring may not begin until the concrete bridge deck has obtained the required curing and strength gain set forth below in **Subsection 814.03.10; Application of External Loads.** Transverse grooving is required and it shall conform to the requirements listed under **Subsection 814.03.9, Para. a**, above.

c. Bridge Decks with Bituminous Overlay and Bridge Deck Waterproofing. Bituminous paving shall not begin until the concrete has adequately cured and attained the required strength as listed under **Application of External Loads.** The surface of the concrete bridge deck shall be left without any projections that might puncture, or depressions that could retain water. The surface shall be as smooth as practical in accordance with the recommendations of the manufacturer of the waterproofing membrane. Requirements of waterproofing the bridge deck shall conform with the requirements set forth in **SECTION 813; WATERPROOFING AND DAMPPROOFING,** of these Specifications.

814.03.10 Application of External Loads. No construction work (including placement of sidewalk, curbing, railing, bituminous pavement, concrete overlays, grooving, etc.), shall be allowed on the newly placed bridge deck until concrete has cured for a minimum of 28 days and has attained the minimum required 28-day compressive strength. No heavy equipment or traffic of any description will be permitted on the concrete deck until authorized by the Engineer.

814.04 METHOD OF MEASUREMENT. This work will not be measured separately for payment.

814.05 BASIS OF PAYMENT. No separate payment will be made for this work. Rather, payment will be included with the payment, and at the contract unit price per cubic yard as listed in the Proposal, for "Concrete Superstructure Class HP(AE) Bridge Deck."

SECTION 815

LATEX MODIFIED CONCRETE FOR BRIDGE OVERLAYS

815.01 DESCRIPTION. This work consists of the placing of a wearing course of latex modified Portland cement concrete on prepared surfaces of either existing or new bridge decks at the locations indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

815.02 MATERIALS. All material components of this modified concrete shall conform to the applicable requirements of **SECTION 601; PORTLAND CEMENT CONCRETE** and **SECTION M.02; PORTLAND CEMENT CONCRETE**, of these Specifications, except as modified herein.

815.02.1 Aggregates.

a. Coarse Aggregate. The coarse aggregate shall be clean, sound crushed stone or crushed gravel meeting the general requirements of AASHTO M80. Grading shall be in accordance with AASHTO M43 size No. 89 for overlay thicknesses up to 1½-inches and AASHTO M43 size No. 68 for overlay thicknesses greater than 1½-inches.

b. Stockpiling Aggregates. Unless otherwise approved by the Engineer, fine and coarse aggregate shall be stockpiled at the job site.

Stockpiles shall be completely covered and no additions to approved stockpiles shall be permitted without the approval of the Engineer.

The free moisture content of each aggregate type, at the time of batching, shall not exceed 7 percent of the saturated-surface dry weight of the fine or coarse aggregate or 8 percent total for both aggregates.

815.02.2 Cement. Portland cement shall be non-air entraining Type II cement.

815.02.3 Latex Emulsion Admixture. Latex emulsion admixture shall conform to the requirements of **Subsection M.02.08** of these Specifications.

The latex admixture shall be agitated as necessary to prevent separation of the emulsion. It shall be maintained in storage within the temperature range 32°F to 85°F. Latex emulsion admixture exposed to temperatures outside the foregoing limits shall be removed and replaced at no cost to the State. The manufacturer of latex emulsion admixture must submit written certification that the material supplied is identical in composition to that prequalified in accordance

with procedural directives of FHWA RD 78-35; "Styrene-Butadiene Latex Modifiers for Bridge Deck Overlay Concrete." A Certificate of Compliance will be provided for every tanker supplied to the project. This certification shall also list particle size, surface tension and infrared fingerprint information for the lot supplied. Field samples will be taken from every tanker of material used on the project and from each mixer truck if deemed necessary by the Engineer.

815.03 CONSTRUCTION METHODS.

815.03.1 Latex Modified Mixture Design. The design of the latex modified concrete shall conform to the requirements of **Para. b** of **Subsection 601.03.1** of these Specifications. The design shall be signed and stamped by a Registered Professional Engineer and submitted for approval to the Engineer. The latex modified concrete shall also meet the following requirements:

	Material or Property	Value
	Cement content, min., (lbs./cu.yd.)	658
	Latex Emulsion Admixture, (gal./cu.yd.)	24.5
*	Water/cement ratio	0.4
	Air Content, (% of Plastic Mix)	5.5 ±1.5
**	Slump, (inches)	3 to 7
	Strength, 28 day, min. compressive strength (psi)	3,500

Notes: * The net water added shall be adjusted to control the slump within the prescribed limits and should produce a maximum net water/cement ratio of 0.40 by weight, including water in latex and aggregate.

** Concrete for the slump test shall be deposited in a clean, non-absorbent container and allowed to stand covered without disturbance for 5 minutes prior to performing the test. Care shall be exercised that traffic vibrations do not affect the measurement. Slump and air content tests will be performed for each calibration and during production at the discretion of the Engineer in order to insure that acceptable material is being produced.

815.03.2 Surface Preparation. All surfaces shall be prepared in accordance with the requirements of **Subsection 816.03.2** of these Specifications.

Except in cases where sawing and sealing of the latex overlay is specified on the Plans, existing expansion joints and dams shall be formed vertically through the overlayment.

815.03.3 Batching and Mixing. All equipment for the deck preparation, mixing, placing and finishing of latex modified cement concrete shall be approved by the Engineer prior to the start of any work.

a. Proportioning and Mixing Equipment shall be self contained, mobile, and capable of continuous mixing subject to the following:

1. The mixer shall be self-propelled and be capable of carrying sufficient unmixed dry, bulk cement, sand, coarse aggregate, latex modifier, and water to produce on the site not less than 6 cubic yards of concrete.

2. The mixer shall be capable of positive measurement of cement being introduced into the mix. A recording meter visible at all times and equipped with a ticket printout shall indicate this quantity.

3. Each mixer shall be inspected and approved by the Engineer. Any mixer not functioning in a manner the Engineer considers acceptable shall be repaired. If repair is impractical, the mixer shall be replaced. Conditions which will automatically designate a mixer unacceptable are (list not intended to be all inclusive): hydrated cement deposits; broken, bent, lose or scalloped mixing paddles; mixing paddles worn 20 percent in any dimension; mixing paddles heavily caked with mortar; and latex or water delivery system out of tolerance.

4. Mixers shall be calibrated at the beginning of placement operations, whenever a mixer leaves and returns to a project and whenever yield tests indicate that batch tolerances are not being maintained. The calibration shall be done in accordance with the Department's Latex Modified Concrete calibration sheet in the presence of the Engineer to accurately proportion the materials within the following tolerances (by weight):

Material	**Percent by Weight**
Coarse Aggregate	±2
Fine Aggregate	±2
Coarse and Fine Aggregate (combined)	±2
Cement	±1
Water	±1
Latex Admixture	±1

The yield of the specified mix shall be true within a tolerance of 1 percent according to the following test:

With the cement meter set on zero and all controls set for the desired mix, activate the mixer and discharge mixed material into a one quarter cubic yard container; 36" x 36" x 9". When the container is level-struck full with a provision for settling the material into all corners, the cement meter must show a discharge of 164.5 pounds of cement for latex modified Portland cement concrete, (658 pounds/cubic yard). This yield shall be performed at least once per mixer per placement or whenever the Engineer deems it necessary to insure proper mixture is being supplied.

5. The mixer shall provide positive control of the flow of water and latex emulsion into the mixing chamber. Water flow shall be indicated by flow meter and be readily adjustable to provide for minor variations in aggregate moisture to maintain the slump within the tolerances stated in this Specification.

6. The mixer shall be capable of being calibrated to automatically proportion and blend all components of the indicated composition on a continuous or intermittent basis as required by the finishing operation, and it shall discharge mixed material through a conventional chute directly in front of the finishing machine.

7. Mixers shall be clean and the ingredients accurately proportioned.

8. Modified Portland cement concrete materials shall be mixed at the site in accordance with the specified requirements for the equipment used. The modified concrete as discharged from the mixer shall be uniform in composition and consistency. Mixing capability shall be such that finishing operations can proceed at a steady pace with final finishing completed before the formation of the plastic surface film.

815.03.4 Limitations of Operations. All weather and concrete temperature requirements shall conform to the applicable requirements of **Subsection 816.03.4** of these Specifications.

815.03.5 Placing and Finishing. Placement and finishing of latex modified concrete shall conform to the requirements of **Subsection 816.03.5** of these Specifications.

815.03.6 Curing Concrete. The curing of latex modified concrete shall conform to the requirements of **Subsections 816.03.7** of these Specifications, except as modified below.

No vehicular traffic shall be permitted on the latex modified concrete surface until 7 days after placement, and until 3,500 psi compression strength is achieved. Compression strength cylinders shall be cured at the job site and under the same conditions as the overlay.

815.03.7 Grooving. The final latex modified concrete deck overlay shall be textured by transverse grooving. Such grooving shall conform to the applicable requirements of **Subsection 814.03.9** of these Specifications.

815.03.8 Defective or Damaged Latex Modified Concrete. All defective or damaged latex modified concrete which occurs prior to the final acceptance of the work shall be repaired or replaced at the Contractor's expense. The defects shall include, but not be limited to, insufficient thickness, cracking, tearing, openness, and damage or other imperfections caused by the Contractor's operations. Repair methods shall be proposed by the Contractor for approval by the Engineer.

815.04 METHOD OF MEASUREMENT. "Latex Modified Concrete for Bridge Deck Overlays" will be measured by the number of cubic feet of modified concrete actually placed in accordance with the Plans and/or as directed by the Engineer. Material wasted, rejected, or used for testing will not be measured for payment.

815.05 BASIS OF PAYMENT. The accepted quantity of "Latex Modified Concrete for Bridge Deck Overlays" will be paid for at the contract unit price per cubic foot as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, equipment, surface preparation, bonding grout, grooving, and all other incidentals required to finish the work, complete and accepted by the Engineer.

SECTION 816

CONCRETE BRIDGE DECK OVERLAYS

816.01 DESCRIPTION. This work consists of placing a Portland cement concrete overlay on a prepared surface of bridge decks, precast concrete butted box beams, deck slabs, deck planks or other specified concrete substrate at the locations indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

816.02 MATERIALS. Portland cement concrete shall be Class HP(AE) and shall conform to all applicable requirements of **SECTION 601; PORTLAND CEMENT CONCRETE**, of these Specifications, except as modified herein.

816.03 CONSTRUCTION METHODS.

816.03.1 Existing Bridge Decks.

a. Surface Scarification. The surfaces of existing bridge decks upon which a concrete overlay is to be placed shall be scarified in an approved manner. The scarification method and depth of removal shall be as specified on the Plans.

b. Surface Preparation. The blast-cleaning of an area of the deck shall be performed before the 24-hour water soak period preceding placement of the overlay on the area. The blast-cleaning shall be performed by a method approved by the Engineer. The blast-cleaning method used shall be performed in conformance with all applicable air and water pollution regulations and applicable safety and health regulations. All debris, including dirty water, resulting from the blast-cleaning operations shall be immediately and thoroughly cleaned from the blast-cleaned surfaces and from other areas where debris may have accumulated. All dust and other debris shall be removed by flushing with water, vacuuming, or blowing with oil-free compressed air. The blast-cleaned areas shall be protected, as necessary, against contamination prior to the 24-hour presoaking. Contaminated areas and areas exposed more than 36 hours after cleaning shall be blast-cleaned again, as directed by the Engineer and at no additional expense to the State.

The prepared surface shall then be soaked with clean water for not less than 24 hours prior to the placement of the Class HP(AE) concrete overlay. The surface shall be maintained in a clean, saturated condition by using polyethylene film or other suitable water impermeable clear covers, until ready to receive the overlay. Before the overlay is applied, all standing water shall be blown off with oil-free compressed air.

816.03.2 Precast Concrete Butted Box Beams, Deck Slabs, or Deck Beams. The surfaces of Precast Concrete Butted Box Beams, Deck Slabs or Deck Planks upon which an overlay is to be applied shall be finished with a roughened surface with amplitude of 1/4" minimum by a method noted on the Plans or as approved by the Engineer.

After the placement and curing of the shear key grout and successful post tensioning of the structural elements is complete, and prior to placing the overlay, the entire area of the deck shall be blast-cleaned in accordance with the requirements set forth in **Subsection**

816.03.1, Para. b. Epoxy coated steel and any other appurtenances cast into the surface of the precast elements shall be protected from the effect of the blast medium so that damage to the epoxy coating does not occur. Any damage resulting from the Contractor's failure to adequately protect the steel shall be repaired by the Contractor at no additional cost to the State.

816.03.3 Bonding Grout. When specified in the Plans, a bonding grout shall be applied as follows: After the surface has been cleaned and wetted, and immediately before placing concrete, a thin (approximately 1/8 inch) coating of bonding grout shall be vigorously and thoroughly broomed, brushed or sprayed onto the saturated bridge deck.

Bonding grout shall consist of equal parts, by volume, of approved Portland cement, microsilica (solids part) and mortar sand with sufficient water to form a slurry. The water-to-cementitious ratio by weight of the bonding grout slurry shall not exceed 0.40. The consistency of the slurry shall be such that it can be applied with a stiff synthetic bristle broom or sprayed onto the prepared concrete surface in a thin, even coating that will not run or puddle.

Bonding grout that has dried or become unworkable, as determined by the Engineer, shall not be incorporated in the work. No retempering will be permitted.

Bonding grout shall be broomed with push brooms. At all joints and concrete surfaces around or below reinforcing steel, brooming shall be done with straight brooms. Care shall be exercised to insure that all prepared surface areas receive a thoroughly even coating, and that no excess bonding grout be permitted to collect in pockets. This shall be done to insure the bonding grout is evenly absorbed into the surface. All surfaces to be in contact with new concrete, including the slab, curb, longitudinal and transverse joints, shall be coated with bonding grout.

The rate of bonding grout application shall be limited to that surface area which can be covered with new concrete before the bonding grout begins to dry out. The application of the bonding grout shall not be more than 5 feet from the leading edge of the overlay. The Contractor shall take measures to insure that no drying out of the bonding grout occurs by having sufficient workmen available. In the event drying does occur, as evidenced by a light gray color, the Contractor shall remove the bonding grout by sandblasting, or other means approved by the Engineer. Wetting or spraying the wet or dry bonding grout shall not be allowed.

816.03.4 Limitations of Mixing.

a. Temperature and Weather Conditions. All weather and concrete temperature requirements shall meet the applicable requirements of **Subsection 814.03.3** of these Specifications except as modified below.

b. Cold Weather Concrete. No Class HP(AE) concrete mixtures shall be placed when ambient temperatures are below 45°F. However, the Class HP(AE) concrete may be placed at 45°F when rising temperatures are forecast and if the forecast indicates temperatures over 45°F for a minimum period of 8 hours after the placement has been completed.

If the air temperatures are such that the minimum temperature will not be met, the Contractor may place concrete if the structure is enclosed and external heat is provided in order to meet specified ambient temperature requirement for placement.

At temperatures above 85°F the Engineer may require placements to be made at night or early morning hours, if, in his opinion, a satisfactory surface finish is not being achieved.

c. Inclement Weather. For structures that are not enclosed, all placing operations shall cease when it starts to rain or snow.

816.03.5 Placing and Finishing. Class HP(AE) concrete overlay shall conform to the placement requirements of **Subsection 814.03.6** of these Specifications except as modified herein. Concrete placement shall not proceed until the Engineer is satisfied that all necessary steps have been taken to insure adequate compliance with the Specifications and that completion of the operation can be accomplished within the required scheduled time. It shall be the Contractor's responsibility to allow sufficient time to permit such an inspection by the Engineer.

a. Finishing Machine. The finishing machine shall conform to the applicable requirements of **Subsection 814.03.7** of these Specifications, except as modified in this Section. The finishing machine shall have one or more rotating rollers and augers. Prior to placing the concrete, screed rails shall be accurately set to insure finishing of the concrete surface to the elevations shown on the Plans.

Provisions shall be made for raising the screed to clear the screeded surface for traveling in reverse. The bottom face of the screed shall be a metal surface 4 inches wide. The screeds shall be provided with positive control of the vertical position.

During the dry test run the finishing machine's screed rails are to be set as close to the final grade as possible to eliminate the need for adjusting the finishing machine by hand at any time during the operation.

Bulkheads shall be formed to the required grade and profile prior to placing the modified concrete overlay.

b. Placement and Consolidation. Concrete placement and initial strike-off shall be coordinated so that initial strike-off is never more than 5 feet behind the concrete placement. The direction of placing the concrete shall be as specified on the Plans.

The concrete shall be consolidated by means of an approved high frequency (3000 to 7000 vpm) vibratory pan which shall be applied in a manner to secure maximum consolidation of the concrete.

Spud vibration will be required in deep pockets, edges and adjacent to joint bulkheads and overlays greater than 3 inches thick.

Handheld vibrators shall be equipped with rubber-tipped heads when used to consolidate around epoxy-coated reinforcement.

A construction dam or bulkhead shall be installed in case of a delay in the placement operations exceeding 30 minutes duration. During delays of 30 minutes or less, the placement

shall be protected with presoaked wet burlap. If the concrete placement is stopped or delayed for 90 minutes or more, further placement shall be discontinued.

The thickness of the mixture shall be verified by probes in the fresh concrete. Sufficient depth checks shall be made at regular intervals behind the machine(s) prior to commencement of the curing operation along the full width of the span to insure conformity to the overlay thickness specified on the Plans.

Screed rails and/or construction bulkheads shall be separated from the newly placed material by passing a pointed trowel along their inside face. Metal expansion dams shall not be separated from the overlayment. Care shall be exercised to insure that this trowel cut is made for the entire depth and length of rails after the mixture has sufficiently stiffened.

Unsatisfactory performance, particularly with respect to the surface smoothness and profile attained, may be cause for rejection of the equipment.

c. Finishing. The finished surface, before texturing, shall be uniformly smooth, dense and even. Variations in pavement surface in excess of 1/8-inch above, or below the proper finished elevation, or surface irregularities of more than 1/8-inch in 10 feet will not be accepted. The concrete surface shall be checked in accordance with the requirements of **Para. c** of **Subsection 814.03.7** of these Specifications.

Hand finishing with a float may be required along the edge of the pour or on small areas or repair. Edge tooling is required at joints, except next to metal expansion dams, curbs, and previously placed lanes.

816.03.6 Testing. Testing shall be in accordance with the RIDOT Master Schedule for the Preparation of a Project Schedule for Sampling, Testing and Certification of Materials.

All compressive strength cylinders shall be field cured at the job site and under the same conditions as the Class HP(AE) concrete overlay.

816.03.7 Curing Concrete. The curing of Class HP(AE) concrete overlay shall conform to the applicable requirements of **Subsections 814.03.2** and **814.03.8; Contractor's Plan** and **Curing**, respectively, of these Specifications, except as modified below.

No vehicular traffic shall be permitted on the Class HP(AE) concrete surface for a minimum period of fourteen days, or until the minimum specified 28-day design compressive strength is achieved.

816.03.8 Grooving. The final Class HP(AE) concrete deck overlay shall be textured by transverse grooving. Such grooving shall conform to the applicable requirements of **Subsection 814.03.9** of these Specifications.

816.03.9 Defective or Damaged Class HP(AE) Concrete. All defective or damaged HP(AE) concrete identified prior to the final acceptance of the work shall be repaired or replaced at the Contractor's expense. Defects shall include, but not necessarily be limited to, insufficient thickness, cracking, tearing, honeycombing, and damage or other imperfections caused by the Contractor's operations. Repair methods shall be proposed by the Contractor for approval by the Engineer.

816.04 METHOD OF MEASUREMENT. "Concrete Bridge Deck Overlays" will be measured by the number of cubic feet or cubic yards of the concrete actually placed in accordance with the Plans and/or as directed by the Engineer.

816.05 BASIS OF PAYMENT. The accepted quantity of "Concrete Bridge Deck Overlays" will be paid for at the contract unit price per cubic foot or cubic yard as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, equipment, surface preparation, bonding grout, grooving, and all other incidentals required to finish the work, complete and accepted by the Engineer.

SECTION 817

REPAIRS TO STRUCTURE CONCRETE MASONRY

817.01 DESCRIPTION. This work consists of making repairs to structure concrete masonry by removing and disposing deteriorated concrete, preparing bonding surfaces of concrete and reinforcing steel, and replacing the deteriorated concrete with approved mortar to the lines and grades specified and at the locations indicated on the Plans or as directed by the Engineer all in accordance with these Specifications.

817.02 MATERIALS.

817.02.1 Pneumatically Applied Mortar (Shotcrete). Materials for shotcrete shall conform to the applicable requirements of **SECTION 601, SECTION 602** and **SECTION M.02**, respectively, of these Specifications, except as modified herein.

Shotcrete shall be produced by either the wet mix process or the dry mix process and conform to the following requirements unless otherwise listed on the Plans:

Material or Property	**Value**
Compressive Strength at 28 days, f_c' (psi)	5,000
Maximum Water/Cementitious Ratio	0.45
Minimum Cement Factor (lbs./cy.)	658
Air Content (percent)	6±1
Slump (inches)	1 to 3

a. Mixture Proportions. The Contractor shall submit for acceptance the recommended mix proportion, strength results, water-cement ratio and source of material. The Contractor shall select mix proportions on the basis of compressive strength tests of specimens continuously moist cured until tested at 28 days or different test age if so specified in accordance with AASHTO T22. The specimens shall be cut from shotcreted test panels not earlier than 5 days

after shotcreting. For mixture acceptance purposes, average core compressive strength must equal to f_c' for cores with Length-to-Diameter (L/D) ratios of 2.0. For cores with L/D between 1.0 and 2.0, use correction factors given in AASHTO T24. For cube specimens, average compressive strength shall be at least equal to $1.15f_c'$. Combined aggregate gradation (fine and coarse) shall meet either gradation #1, #2, or #3 of Table 2.2.1 of ACI 506.2 as specified on the Plans.

Premixed and prepackaged concrete products specifically manufactured as a shotcrete product may be provided for the dry mix shotcrete process only as approved by the Engineer. The packages shall contain cement and aggregates conforming to the materials requirement of this Specification and the product must be listed on the Department's Approved Materials List.

817.02.2 Patching Mortar. Patching mortar shall conform to the requirements of ASTM C928; "Rapid Hardening or Very Rapid Hardening Mortar" as listed on the Plans, and be listed on the Department's Approved Materials List. The mortar shall be non-shrink, non-sag, and shall contain no ferrous additives. Repair mortars not previously approved must be submitted for approval to the Engineer 30 days before intended use. All materials shall be used in accordance with manufacturer's recommendations.

817.02.3 Reinforcement. Bar reinforcing steel shall conform to the requirements of **Subsection M.05.01** of these Specifications. Wire reinforcement shall be 2" x 2" - W1.4 x W1.4 (minimum), galvanized, welded wire fabric shall conform to the requirements of **Subsection M.05.02** of these Specifications.

817.02.4 Epoxy Bonding Agent. Epoxy Bonding Agent shall be an all-purpose high-strength, moisture-insensitive, 2-part rigid epoxy adhesive conforming to the requirements of ASTM C-881, Type V, and it shall meet the approval of the Engineer, including contact time, fluidity and application temperature. The bonding agent shall also be one of those listed on the Department's Approved Materials List.

817.02.05 Portland Cement Slurry. Portland cement slurry shall consist of equal parts, by volume, of approved Portland cement and concrete or mortar sand with sufficient water to form a slurry.

817.03 CONSTRUCTION METHODS.

817.03.1 Surface Preparation (All Repair Methods). All deteriorated soft or honeycombed concrete shall be removed from the areas to be repaired by means of suitable power and hand tools to a uniform depth, sufficient to expose a bonding surface of sound material. Power tools that cause over-breakage of concrete will not be allowed. Chipping hammers shall weigh less than 40 pounds. In areas where reinforcing steel is found to be surrounded by deteriorated concrete or where at least one-half of the rebar surface area is exposed, the depth of concrete removal shall be such as to include all deteriorated concrete but not less than that depth necessary to allow for one inch minimum annular clearance around the reinforcing bars. All corroded reinforcing bars shall be thoroughly cleaned to remove all rust. Those bars that have lost 1/4 or more of their original diameter shall be supplemented by new bars spliced in place. New bars considered main reinforcement, shall be lapped sufficiently (30 diameters on both sides of the effected areas) to develop the full strength of the bar. If necessary, additional chipping will be required to provide this lap. Dual bars of equivalent or greater section may be used.

The boundaries of areas to be repaired shall be square cut, or slightly undercut to a depth of not less than one inch. Thin or feathered edges will not be permitted.

All chipped areas, corroded rebars and masonry surfaces to be repaired shall be thoroughly cleaned by means of compressed air, sandblasting, air and waterblasting, steam, wire brushing or by other methods approved by the Engineer. The Contractor may use one or all of the various means of cleaning chipped areas as approved or as ordered by the Engineer.

Care shall be taken during the removal of the designated portions of the structure to avoid damaging the portions that are to remain in place. Any damage caused by the Contractor to the existing structure that is designated to remain in place shall be repaired or replaced by the Contractor at its own expense to the satisfaction of the Engineer.

The surface against which mortar is to be placed shall be kept wet for at least one hour and then allowed to dry to a saturated surface dry condition just prior to application of the mortar.

817.03.2 Placement of Reinforcing. Repairs less than 1½-inches thick will not require wire mesh reinforcement unless otherwise specified by the Engineer. In cases where the thickness of the repair mortar exceeds 1½-inches and existing bar reinforcement is available, galvanized wire mesh shall be attached to the bars with tie wire. If existing rebar is not available, wire mesh shall be installed by means of mechanical concrete anchors in accordance with the requirements of Table 1. For areas where the repair exceeds 4 inches, a single layer of wire mesh shall be used to reinforce each 2-inch thickness of patch material.

Table 1

Size and Spacing of Anchors

Thickness of Placement (in.)	Overhead Surfaces Dia.(in.) Spacing (in.)	Vertical Surfaces Dia. (in.) Spacing (in.)	Top Horizontal Surfaces Dia. (in.) Spacing (in.)
1½ to 4	1/4 at 24	1/4 at 24	1/4 at 36
4 to 5	1/4 at 20	1/4 at 24	1/4 at 36
5 to 6	3/8 at 17	3/8 at 21	3/8 at 36
over 6	3/8 at 16	3/8 at 20	3/8 at 36

Mechanical concrete anchors shall be a hooked type expansion bolt to be approved by the Engineer. The exposed end of each anchor shall have at a minimum a right angle bend for engaging reinforcement. At least three anchors shall be used in each individual patch area.

If any reinforcement is damaged by the Contractor during the repair procedure, the bars shall be replaced as required by the Engineer at the Contractor's expense.

817.03.3 Application of Pneumatically Applied Mortar (Shotcrete).

a. Submittals. Submittal shall include shop drawings, details, material and mill test certificates, mix designs, staff qualifications, construction procedures, detailed construction sequencing plans, and shop drawings for temporary debris shields. Shop drawing shall be

submitted a minimum of 21 calendar days prior to the commencement of the work.

The Contractor shall submit documentation showing that project personnel have appropriate qualifications. Inadequate proof of personnel qualifications shall be cause for withholding construction approval. Changes to previously approved personnel must be approved in writing. Shotcreting nozzle operators shall have at least one year of experience in the application of shotcrete on projects of comparable nature or work under the immediate supervision of foreman or instructor with at least two years of such experience.

The Engineer shall approve or reject the Contractor's working drawings, design submission, and staff qualifications within ten working days after receipt of the submission. Work shall not begin until the Contractor's qualifications are approved. The Engineer may suspend the work if the Contractor substitutes unqualified personnel for approved personnel during construction. If work is suspended due to the substitution of unqualified personnel, the Contractor shall be fully liable for additional costs resulting from the suspension of the work and no adjustments in contract time resulting from the suspension will be allowed.

b. Batching and Mixing. Aggregate and cement may be batched by weight or by volume. Mixing equipment shall be capable of thoroughly mixing the materials in sufficient quantity to maintain placing continuity. Ready mix shotcrete shall comply with the applicable requirements of **Subsections 601.03.2** and **601.03.3**, respectively, of these Specifications.

c. Delivery Equipment. The mortar shall be applied by pneumatic equipment that sprays the mix onto the prepared surface at a high velocity as needed to produce a compacted dense homogeneous mass. The air compressor and delivery hose lines shall be of adequate capacity and size to provide a minimum pressure of 35 psi at the nozzle for one-inch nozzles and proportionally greater for larger nozzles. The compressor shall be of adequate capacity to maintain a sufficient, constant nozzle velocity for all parts of the work while simultaneously operating a blow pipe for cleaning away rebound. The air hose shall be equipped with a filter to prevent any oil or grease from contaminating the shotcrete. The velocity of the material as it leaves the nozzle must be maintained uniform at a rate determined for the given job conditions to produce minimum rebound.

1. Dry Mix Process. The delivery equipment shall be capable of delivering a continuous, smooth uniformly mixed material to the nozzle. The nozzle shall be equipped with a water ring and valve to permit adjustment of the water. The water added to the dry mix at the nozzle shall be maintained at a pressure at least 15 psi greater than the air pressure. The nozzle shall be capable of delivering a conical discharge stream.

2. Wet Mix Process. Only pneumatic-feed type delivery equipment will be allowed.

d. Pre-Construction Testing. Test panels shall be made by each application crew using the equipment, materials, mixture proportions and procedures proposed for the job prior to the commencement of the work. A test panel at least 30" x 30" shall be made for each mixture being considered and for each shooting position to be encountered in the job. The test panels shall be fabricated to the same thickness as in the structure, but not less than 4 inches. Take at least five, 3-inch diameter cores from each panel for testing in accordance with AASHTO T24. Samples for testing shall be obtained by the Contractor in the presence of the Engineer, and tested by the Engineer. Field cure the samples in the same manner as the work, except that the test specimens shall be soaked in water for a minimum of 40 hours prior to testing. When the length

of the core is less than twice the diameter, apply the correction factors given in AASHTO T24 to obtain the compressive strength of individual cores. The average compressive strength of three cores taken from the test panel shall equal or exceed $0.85f_c'$ with no individual core less than $0.75f_c'$. The average of three cubes taken from a panel of shotcrete must equal or exceed f_c' with no individual cube less than $0.88f_c'$.

e. Placement of Mortar. Shotcrete shall be applied with the same equipment and the same technique as used to construct the approved test panels. Nozzle operators constructing the test panels are to be the same operators used in placing shotcrete in the work. The mortar shall be applied as dry as practicable to prevent shrinkage cracking and preclude sagging or sloughing off.

Shooting guide strips or wires shall be employed to insure square corners, straight lines and a plane surface of mortar, except as otherwise specified on the Plans or approved by the Engineer. They shall be so placed as to keep the trapping of rebound at a minimum. The re-use of rebounded materials will not be permitted. In shooting all surfaces, the stream of flowing material from the nozzle shall impinge as nearly as possible at right angles to the surface being covered, and the nozzle shall be held from 2 to 4 feet from the working surface. Thickness measuring pins shall be installed on 5-foot centers in each direction. The pins shall be non-corrosive. Other methods to establish if the required minimum thickness of shotcrete is being applied may be approved if the Contractor can satisfactorily demonstrate the reliability of these other methods.

A sufficient number of mortar coats shall be applied to obtain the required thickness. On vertical and overhead surfaces, the thickness of each coat shall not be greater than 1 inch, except as approved by the Engineer, and shall be so placed that it will neither sag nor decrease the bond of the preceding coat. The time interval between successive layers in sloping, vertical or overhanging work, shall be sufficient to allow initial set but not final set to develop. At the time initial set is developing, the surface shall be cleaned to remove the thin film of laitance in order to provide for a bond with succeeding applications. Rebound or accumulated loose sand shall be removed from the surface by brooming or scraping to be covered prior to placing of the original or succeeding layers of mortar and shall not be embedded in the work. All laitance which has been allowed to take final set must be removed by sandblasting and thoroughly cleaning the surfaces.

Care shall be taken to thoroughly wash down all previously hardened concrete with water and compressed air before shooting new material.

The wire fabric shall be positioned to prevent vibration while the shotcrete is being applied. Lap mesh one and a half squares in both directions. Tie wires shall be bent flat in the plane of the mesh and not form large knots. A minimum cover of 2 inches of shotcrete shall be required.

The shotcrete shall be applied from the bottom up to prevent accumulation of rebound on the surface still to be covered. Shotcrete shall emerge from the nozzle in a steady uninterrupted flow.

Horizontal and vertical corners and any area where rebound can not escape or be blown free shall be filled first. Nozzle shall be held at such distance and angle to place material behind reinforcement before material is allowed to accumulate on its face. Do not place shotcrete through more than one layer of reinforcing steel rods or mesh in one application. Unless suitable

means to screen the nozzle is provided, discontinue shotcreting if wind or air currents will cause separation of the stream during placement.

Check for hollow areas by hammer sounding. An approved method shall be used to correct deficient areas. Deficient areas shall be corrected at the Contractor's expense.

Surface defects shall be repaired as soon as possible after initial placement of the shotcrete. All shotcrete which lacks uniformity, exhibits segregation, honeycombing, or lamination, or which contains any dry patches, slugs, voids, or sand pockets shall be removed and replaced with fresh shotcrete at the Contractor's expense.

f. Construction Testing. Contractor shall prepare one test panel for every 50 cubic yards of shotcrete placed or one panel per shift. Test panel shall have minimum dimensions of 18" x 18" x 4" gunned in the same position as the work represented. Panels shall be gunned during the course of the work by the Contractor's regular nozzleman. The Contractors shall cure the panels and obtain a minimum of three cores as described under "Preconstruction Testing." Cut cores shall be tested by the Engineer in accordance with the requirements listed under "Preconstruction Testing."

g. Limitation of Mixing. Shotcrete shall be placed in accordance with the temperature and weather conditions listed under **Subsection 814.03.3** of these Specifications.

h. Finish. All exposed surfaces shall be finished straight and true, approximating the original contour as close as practicable. The final finish shall have a steel trowel, wood float or other finish approximating the existing adjacent concrete finish.

i. Curing. Should the placing operations be suspended overnight, the Contractor shall maintain the exposed shotcrete surfaces continuously moist until operations are resumed. Surfaces shall be kept moist by either continuously sprinkling, or absorptive mat/fabric kept continuously wet.

Immediately upon completion of final shotcreting operations. The Contractor shall continue moist curing, as specified above for a period of 7 days after shotcreting. Contractor may use an approved curing compound in accordance with the requirements of **Subsection M.02.04** of these Specifications. Curing compounds shall not be used on any surfaces against which additional shotcrete or other cementitious finishing materials are to be bonded.

817.03.4 Application of Patching Mortar.

a. Limitation of Mixing. Concrete patching mortar shall be mixed and applied in strict accordance with the manufacturer's recommendations.

b. Placing and Consolidation. Prior to placing the patching mortar, an epoxy bonding agent or a Portland cement slurry, as specified on the Plans, shall be applied to all exposed reinforcing and mating concrete surfaces.

The Contractor shall follow the manufacturer's recommendations for curing the epoxy bonding agent prior to placing the patching mortar. The patching mortar shall not be placed if the epoxy bonding agent has exceeded the manufacturer's recommended contact time. If the epoxy bonding agent has exceeded its contact time, the Contractor shall follow the manufacturer's

recommendations for re-application. An epoxy bonding agent with an extended contact time should be used if required by the timing of concrete placement and/or weather conditions.

The patching mortar shall not be placed if the Portland cement slurry has dried out. Should the Portland cement slurry dry out prior to placing the patching mortar, the Contractor shall remove the slurry by sandblasting or other means as approved by the Engineer. Wetting or spraying the wet or dry slurry shall not be allowed.

The patching mortar shall be placed in accordance with the manufacturer's recommendations, otherwise it shall be placed in 1-inch lift layers maximum, within 5-to-10 minutes after mixing water is added to avoid the rapid setup of the material.

If more than one lift layer is required to perform the repair, the previously placed lift layer shall not be allowed to dry. Its surface shall be roughened prior to placing the next layer.

c. Curing and Protection. Curing of the patching mortar shall be in accordance with the manufacturer's recommendations.

d. Final Finish. Repaired surfaces shall be finished to closely match the color and original contour of surfaces adjoining the repair areas. If, in the opinion of the Engineer, the repaired surface does not closely match the adjacent unrepaired surface, the repair shall be removed and the repair process repeated or modified as approved by the Engineer. Where bulges, offsets, and other irregularities exceed the specified tolerances, the protrusions shall be reduced so that the surfaces are within the specified limits. No extra compensation will be furnished to the Contractor for any repeated repairs.

817.04 METHOD OF MEASUREMENT. "Repairs to Structure Concrete Masonry - Pneumatically Applied Mortar" and "Repairs to Structure Concrete Masonry - Patching Mortar" will be measured by the number of cubic feet of the respective mortars actually applied in accordance with the Plans and/or as directed by the Engineer.

817.05 BASIS OF PAYMENT. The accepted quantities of "Repairs to Structure Concrete Masonry - Pneumatically Applied Mortar" and "Repairs to Structure Concrete Masonry - Patching Mortar" will be paid for at the respective contract unit prices per cubic foot as listed in the Proposal. The prices so stated shall constitute full and complete compensation for all labor, materials, equipment and scaffolding, and all other incidentals required to finish the work, complete and accepted by the Engineer.

SECTION 818

PORTLAND CEMENT CONCRETE BRIDGE DECK REPAIR

818.01 DESCRIPTION. This work consists of removing deteriorated concrete from reinforced concrete bridge deck surfaces, erecting the necessary form-work for supporting new concrete and placing new Portland cement concrete, all in accordance with these specifications.

a. Partial Depth Removal. The limits of partial depth concrete removal shall be those areas for which deteriorated concrete extends less than 50 percent of the depth of the original deck as indicated on the Plans.

b. Full Depth Removal. The limits of full depth concrete removal shall be those areas for which deteriorated concrete extends more than 50 percent of the depth of the original deck as indicated on the Plans.

818.02 MATERIALS. Materials shall conform to the following requirements:

818.02.1 Concrete shall conform to the requirements for Class XX(AE) material as set forth in **Subsections 601.01.1** and **601.03.1; Classification** and **Proportioning**, respectively, with the following modifications.

Coarse Aggregate Gradation	Percent Passing Min.	Max.
3/4 inch sieve	100	---
½ inch sieve	95	100
3/8 inch sieve	40	90
#4 sieve	5	30
#200 sieve	0	1.5

Field conditions may necessitate that the Engineer direct the Contractor to substitute rapid setting concrete for the above-specified concrete. The rapid setting concrete shall meet the approval of the Engineer.

818.02.2 Epoxy Adhesive shall be an all-purpose, high-strength, moisture-insensitive, rigid epoxy adhesive. Such adhesive shall meet the approval of the Engineer.

818.03 CONSTRUCTION METHODS.

818.03.1 Removal of Deteriorated Concrete. Removal of concrete shall be performed in a workmanlike manner to prevent damage to the bridge deck that is to remain. If any damage to that portion of the bridge deck to remain, or to the structural girders, does develop due to the Contractor's operations, it shall be repaired or replaced by the Contractor to the satisfaction of the Engineer at its sole expense.

All loose, deteriorated, or unsound concrete shall be removed from those portions of the bridge deck surfaces designated by the Engineer.

A saw cut to a maximum depth of 3/4-inch shall be made along all boundaries of the repair patches except those patches bounded by the bridge curbing. Particular care shall be taken not to cut into the top mat of bridge deck reinforcing steel.

Care shall be taken not to damage the freshly saw cut edge and the bridge deck reinforcing during the concrete removal operations.

The concrete shall be removed to a depth of not less than 1 inch by a method approved by the Engineer. "Jackhammers" heavier than nominal 30-pound class shall not be used. "Chipping Hammers" heavier than a nominal 15-pound class shall not be used to remove concrete from beneath any reinforcing bar. Hand tools such as hammers and chisels shall be provided for removal of final particles of unsound concrete or to achieve the required depth. In no case shall pneumatic tools be placed in direct contact with reinforcing steel so as to damage its bond to the surrounding concrete.

In areas where reinforcing steel is found to be surrounded by deteriorated concrete or where at least one-half of its surface area is exposed, the depth of concrete removal shall be such to include all deteriorated concrete but not less than that depth necessary to allow for 3/4-inch clearance below the reinforcing bars. Those reinforcing bars that have lost 1/4 or more of their original diameter shall be supplemented by new bars spliced in place. In splicing new bars, they shall be lapped sufficiently (30 diameters on both sides of the effected areas) to develop the full strength of the bar and, if necessary, additional chipping will be required to provide this lap. Dual bars of equivalent or greater section may be used.

a. Deck Removal by Hydrodemolition. For deck removal by hydrodemolition methods, see **SECTION 840** of these Specifications.

818.03.2 Preparation of Sound Concrete and Reinforcing. All exposed reinforcing bars and newly exposed concrete shall be thoroughly cleaned by sandblasting or other mechanical abrasion methods approved by the Engineer.

The exposed concrete and reinforcing steel surfaces shall be free of rust, oil, solvent, grease, dirt, dust, bitumen, loose particles, and other foreign matter just prior to the application of the epoxy adhesive. A large sized vacuum cleaner and/or an air jet shall be used to remove dust and other particles just prior to placing the epoxy adhesive.

818.03.3 Forms for Full Depth Removal. Forms used for the patching work shall be capable of supporting the quantity of fresh concrete needed to install the patch and shall otherwise conform to the applicable requirements of **Subsection 808.03.4** of these Specifications.

818.03.4 Epoxy Adhesive shall be applied to the substrate with a stiff-bristled broom to a thickness of approximately 20 mils or in accordance with the recommendations of the manufacturer of the material.

The Contractor shall also follow the manufacturer's recommendations for curing the epoxy adhesive prior to placing the concrete.

818.03.5 Placing and Finishing Concrete. The new concrete shall be hand manipulated and struck off slightly above the final grade. It shall then be mechanically consolidated and screeded to a final grade.

Hand finishing with a wood float may be required to produce a tight and uniform surface.

As soon as finishing has been completed, all vertical joints with adjacent concrete shall be sealed by painting with thinned grout.

White pigmented liquid curing compound shall be applied immediately after the joint application is completed. The rate of application shall be 15 square yards per gallon. A second application may be required for positive protection and uniformity. If the curing compound is not applied within 10 minutes after the final screeding, the finished concrete surfaces shall be immediately covered with wet burlap until the application of curing compound can be made. Failure to apply either curing compound within 10 minutes or burlap within 30 minutes after the concrete is deposited on the floor shall be cause for rejecting the work so effected. Repaired concrete in the rejected areas shall be removed, and the re-repair shall be implemented at no additional cost to the State.

A minimum of four days shall be required for curing the new concrete prior to the placement of the wearing surface.

Traffic shall not be allowed on the repaired deck surfaces until the concrete has reached a minimum of 80 percent of its 28-day compressive design strength.

818.04 METHOD OF MEASUREMENT. "Portland Cement Concrete Deck Repair (Partial Deck Removal)" and "Portland Cement Concrete Deck Repair (Full Deck Removal)" will be measured by the number square feet of such repairs actually made in accordance with the Plans and/or as directed by the Engineer.

818.05 BASIS OF PAYMENT. The accepted quantities of "Portland Cement Deck Repair (Partial Deck Removal)" and "Portland Cement Concrete Deck Repair (Full Deck Removal)" will be paid for at the respective contract unit prices per square foot as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, tools, materials, and equipment, and all other incidentals required to finish the work, complete and accepted by the Engineer.

a. Rapid Setting Concrete. In the event that the Engineer directs the use of rapid setting concrete, the Contractor will only be compensated additionally for the difference in material cost of the concrete in place.

SECTION 819

DRILL AND GROUT REINFORCING DOWELS

819.01 DESCRIPTION. This work consists of the setting of reinforcing bar dowels in existing concrete or granite at the locations indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

819.02 MATERIALS.

819.02.1 Reinforcing Dowels. Reinforcing dowels shall conform to the requirements of **Subsection M.05.01; Bar Reinforcement**, of these Specifications.

819.02.2 High Strength Non-Shrink Grout. High strength non-shrink grout shall be suitable for outdoor use, and it shall have a minimum compression strength of 8,000 psi after 28 days as determined by testing under ASTM C109. It shall not exhibit any measurable decrease in volume after curing. All grout materials shall be listed on the Department's Approved Materials List.

819.03 CONSTRUCTION METHODS. Holes for the dowels shall be drilled at the designated locations. The diameter of the holes and the embedment lengths shall be as indicated in the following table:

Size of Bar	Min. Hole Dia. (in.)	Min. Embedment Length (in.)
#4	1¼	8
#5	1⅜	10
#6	1½	12

819.04 METHOD OF MEASUREMENT. "Drill and Grout Dowels" will be measured by the number of dowels actually installed in accordance with the Plans and/or as directed by the Engineer.

819.05 BASIS OF PAYMENT. The accepted quantity of "Drill and Grout Dowels" will be paid for at the contract unit price per each as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, equipment, tools, and all other incidentals required to finish the work, complete and accepted by the Engineer.

The cost for furnishing the dowels shall be included in the appropriate reinforcing steel item as listed in the Proposal.

SECTION 820

CONCRETE SURFACE TREATMENT PROTECTIVE COATING

820.01 DESCRIPTION. This work consists of providing two or more applications of a uniform coating to those concrete surfaces indicated on the Plans, or as directed by the Engineer, all in accordance with these Specifications.

820.02 MATERIALS. Concrete protective sealers shall conform to the requirements of **Subsection M.12.03** of these Specifications.

820.03 CONSTRUCTION METHODS.

a. Surface Preparation.

1. Concrete to be coated shall be thoroughly clean and free of any efflorescence, laitance, frost, grease, curing compounds, form release oil, etc. or foreign substances. Surface preparation shall be performed in strict accordance with the manufacturer's recommendations for the selected product. In the absence of such recommendations, surface preparation shall be as follows: Clean surfaces by high pressure water washing, with sand to remove loose cementitious material, and any sheen on smooth concrete. This cleaning must be completed no more than 48 hours prior to coating the concrete.

2. Concrete surface shall not be coated earlier than 21 days after concrete has been placed and finished.

3. All adjacent surfaces not specified to be coated shall be properly masked to protect from potential over-spray or spillage.

4. Areas adjacent to the surface to be coated shall be cleaned by high pressure water washing prior to commencing work.

b. Application.

1. The protective coating shall be applied evenly in a continuous operation over all surfaces to be treated in order to obtain a uniform coat. The work shall be scheduled so that the stopping point each day falls at an opening, column or corner.

2. Further application procedure shall follow the manufacturers recommendations.

3. Protective concrete surface treatment shall not be applied at temperatures below 50°F or when the relative humidity is above 85 percent. The coating shall not be applied in the rain, at the imminent approach of rain or when it is windy so that it adversely affect the application procedure. The time interval between coats shall be as recommended by the manufacturer.

4. For two-component products, the Part A to Part B mixing ratio (±2 percent tolerance) shall remain in the ratio specified by the manufacturer throughout the application. Failure to so maintain this ratio shall be a basis of rejection.

5. The protective coating shall be applied by airless spray equipment. The spray equipment shall be capable of providing a uniform, consistent protective coat, without splatter, holidays or other defects. The spray equipment must be approved by the Engineer prior to the start of application. Additionally, when the spray equipment has to apply a coating consisting of two or more parts, then the spray equipment shall be capable of automatically shutting down if the mixing ratio cannot be maintained with the tolerance specified.

(a) Suggested spray equipment:

"Graco" Airless Spray Gun #208-327, Tip #163-817, Pump 226-175, equipped with an accessory to monitor the fluid pressure which shuts off automatically if outside the pressure setting, Ratio 30:1.

Compressor (Minimum) 8HP Flow, Fluid ozs./min: 67.

Note: Other models of equipment are available to suit operational needs.

6. The Contractor shall start at the top of the structure, holding the spray gun at a 45 degree angle to the substrate 12 inches to 18 inches from the surface, spraying in a back and forth motion, and at all times shall overlap each pass by approximately 50 percent. Application to each new section shall be made by holding the spray fan evenly centered on the line where treatment of the previous section was terminated, taking care not to deposit excess material. The procedure shall be repeated on spots which absorbed erratically or too quickly. Runs or sags shall be brushed out immediately.

7. Coverage shall be applied at both the rate and the number of coats as recommended by the manufacturer of the selected product.

8. The applicator should be qualified and experienced in the proper application procedure for the concrete sealer.

9. The operation may commence or proceed only when a Department inspector is present.

820.04 METHOD OF MEASUREMENT. "Concrete Surface Treatment Protective Coating" will be measured by the number of square feet of concrete surface actually coated in accordance with the Plans and/or as directed by the Engineer.

820.05 BASIS OF PAYMENT. The accepted quantity of "Concrete Surface Treatment Protective Coating" will be paid for at the contract unit price per square foot as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, and equipment, including surface preparation and all other incidentals required to finish the work, complete and accepted by the Engineer.

SECTION 821

SAWING AND SEALING JOINTS IN BITUMINOUS CONCRETE PAVEMENTS

821.01 DESCRIPTION. This work consists of making two saw cuts, one within the other, in the finished bituminous concrete pavement directly over the transverse joints and edge of deck, and filling the cuts with a hot poured asphalt rubber compound at the locations indicated on the Plans, or as directed by the Engineer, all in accordance with these Specifications.

821.02 MATERIALS. Poured joint seal material shall be an asphalt rubber compound of the hot poured type conforming to AASHTO M301 and approved by the Engineer.

821.03 CONSTRUCTION METHODS. The intent of the work under this provision is to establish a weakened plane joint to control reflectance cracking in the newly installed bituminous concrete pavement at the piers and abutments.

The cuts shall be made directly over the transverse joints at the piers and the edge of deck at the abutments. After the cuts have been satisfactorily completed they shall be sealed with the hot asphalt rubber joint sealer.

821.03.1 Sawing Joints. The bituminous concrete shall have aged sufficiently to allow clean cuts to be made and to withstand the eroding effects of the saw or other cutting device.

The saw cutting of the joint shall be made with an approved power driven saw. The initial saw cut shall be 3/8-inch wide by ½-inch deep. The second saw cut, 1/8-inch wide and 1 inch deep, shall be made within the initial saw cut and shall be, as nearly as practical, centered on the initial saw cut. The saw cuts shall be made with an abrasive blade and sawn dry.

The completed cuts shall extend in a straight line across the pavement from curb to curb.

Each joint to be sawed will be referenced by the Contractor. It shall be the responsibility of the Contractor to insure that the saw cuts are constructed directly over the deck joints at the piers and the edge of deck at the abutments.

821.03.2 Sealing Joints. The sawed joints shall be sealed immediately after the second saw cut has been made. Traffic shall not be allowed to knead together or damage the sawed joint. Each joint shall be thoroughly cleaned and dried prior to placement of the sealing compound. Any cleaning required shall be performed by blowing out all dirt, dust, or deleterious matter that may have accumulated in the sawed joints. Sufficient air pressure shall be provided to insure thorough cleaning.

A combined melter and pressure application shall be used. The melter shall be either oil or gas-fired, and shall be of the double walled, oil bath type with a power-driven mechanical agitator and circulating pump. It shall be equipped with a thermostat to maintain the sealing compound within the range of temperatures specified by the manufacturer and with a suitably mounted thermometer to indicate the temperature of the sealing compound in the melter.

The joint seal shall be applied with a mobile carriage and rubber shoe, and the system shall have a flow control valve which allows all cracks to be filled to refusal so as to eliminate all voids or entrapped air and not leave unnecessary surplus crack sealer on the pavement surface. The hot seal shall completely fill the joint, such that, after cooling, the level of the sealer will not be greater than 1/8-inch below the pavement surface. Any depression in the seal greater than 3/16-inch shall be brought up to the specified limit by the further addition of hot seal. Care shall be taken in the sealing of the joints so that the final appearance will present a neat fine line. Overfilling of joints will not be allowed, and spillage of the sealer shall be avoided. All workmanship shall be of the highest quality, and all excess or spilled sealer shall be removed from the pavement by approved methods and discarded. The melting temperature of the sealer will be furnished by the manufacturer, and the actual temperature of the material in the melter shall not exceed the melting temperature by more than 15°F.

821.04 METHOD OF MEASUREMENT. "Sawing and Sealing Joints in Bituminous Concrete Pavement" will be measured by the number of linear feet actually sawed and sealed in accordance with the Plans and/or as directed by the Engineer.

821.05 BASIS OF PAYMENT. The accepted quantity of "Sawing and Sealing Joints in Bituminous Concrete Pavement" will be paid for at the contract unit price per linear foot as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, tools, materials, equipment, and other incidentals required to finish the work complete and accepted by the Engineer.

SECTION 822

SILICONE HIGHWAY JOINT SEAL

822.01 DESCRIPTION. This work consists of providing silicone joint sealant in highway and bridge expansion and contraction joints at the locations indicated on the Plans, or as directed by the Engineer, all in accordance with these Specifications.

822.02 MATERIALS. The silicone joint sealant shall be a one-part silicone material that readily extrudes over a wide temperature range and cures to produce a durable, flexible, low modulus, silicone rubber seal. The material shall have an extension recovery of 100 percent and a compression recovery of 50 percent of the original joint width.

The silicone sealant shall conform to the requirements of Federal Specifications TT-S-01543 A Class A (one-part silicone sealants) and TT-S-00230 C Class A (one component sealants).

822.03 CONSTRUCTION METHODS.

All joints shall be cleaned of contaminants and impurities to the depth at which the sealant (and backer rod if detailed) is to be installed. Cleaning shall be by grinding, saw cutting, blast cleaning (sand or water), mechanical abrading or a combination of these methods. This will provide a sound, clean and frost-free surface for sealant application.

All dust, loose particles and other debris shall be blown out with oil free compressed air.

An expanded closed cell polyethylene foam rod back-up material shall be installed in joints, or an approved bond breaker tape shall be installed if so detailed on the Plans.

A primer shall be applied to the surfaces of steel expansion joints. The primer shall be as per the recommendation of the sealant manufacturer.

Silicone highway joint sealant shall be applied in a continuous operation to properly fill and seal the joint width. It shall be applied not thicker than ½-inch and no thinner than 1/4-inch with an approximate width to depth ratio of 2-to-1.

For maximum performance the sealant should be applied above 40°F. The sealant shall be pumped directly from the original drum or pail into the joint by use of an air powered pump, pushing the sealant ahead to form a uniform bead. The sealant shall fill the joint from the bottom to slightly below the pavement surface.

The joint shall be tooled using a blunt instrument, so that it is slightly concave and approximately 1/4-inch below the adjacent surface. Tooling should be done within 10 minutes of application before a "skin" forms. No soap or oil shall be used as a tooling aid.

Traffic shall be kept off the sealed lane for at least 30 minutes after sealant application.

822.03.1 Limitations. Silicone sealant is not intended for continuous water immersion, and it should not be applied in totally confined spaces where the sealant is not exposed to atmospheric moisture. The sealant should never be applied to wet or damp surfaces nor should it be installed during inclement weather.

822.04 METHOD OF MEASUREMENT. "Silicone Highway Joint Sealant" will be measured by the number of linear feet of each type of joint actually installed in accordance with the Plans and/or as directed by the Engineer.

822.05 BASIS OF PAYMENT. The accepted quantities of "Silicone Highway Joint Sealant" of the various types will be paid at their respective contract unit prices per linear foot as listed in the Proposal. The prices so-stated constitute full and complete compensation for all silicone sealant, backer rods, bond breaker tape, primer, surface preparation, other materials, labor, tools, equipment, and all other incidentals required to finish the work, complete and accepted by the Engineer.

SECTION 823

ROADWAY JOINTS - EXPANSION AND FIXED

823.01 DESCRIPTION. This work consists of the provision of various types of roadway joints, both expansion and fixed, between bridge decks and abutments or between sections of bridge decks at intermediate piers. Deck joints specified in this provision include compression type neoprene joints, strip seal joints, and asphaltic bridge deck joints. Other types of roadway joints, if required, will be specified in the Special Provisions. Deck joints shall be fabricated and installed in accordance with the details indicated on the Plans, or as directed by the Engineer, all in accordance with these Specifications.

823.01.1 Compression Type Neoprene Deck Joints. This type of joint consists of structural steel components anchored to the deck slab or abutment with preformed neoprene sealer placed between these structural elements. The neoprene sealer is approximately 1¼-inches wide for fixed joints and approximately 3 inches wide for expansion joints.

823.01.2 Strip Seal Expansion Joints. This type of joint consists of specially designed rolled steel sections that are anchored to the deck slab or abutment. The steel section contains a

groove into which is inserted a pre-moulded neoprene strip seal. This deck joint system is a commercial product and must be installed in strict accordance with the manufacturer's recommendations. Manufacturers of this joint system are included in the Department's Approved Materials List.

823.01.3 Asphaltic Expansion Joint System. This type of joint consists of the placement of a 20-inch nominal width, or as otherwise indicated on the Plans, of a special asphalt material with unique elastic properties over concrete deck joints in the space usually occupied by the bituminous wearing surface. This deck joint system is a commercial product and must be installed in strict accordance with the manufacturer's recommendations. Manufacturers of this joint system are included in the Department's Approved Materials List.

823.02 MATERIALS.

823.02.1 Compression Type Neoprene Deck Joints.

a. Structural Steel. Structural steel bars and plates shall conform to AASHTO M270, Grade 36, hot-dipped galvanized. Stud anchors shall conform to ASTM A108.

b. Sealer and Adhesive. The neoprene sealer shall be a preformed extruded type. The sealer and adhesive shall conform to the requirements of **Subsection M.02.10.3** of these Specifications.

c. Aluminum Sheet Metal. The aluminum sheet metal shall conform to AASHTO M274.

d. All metal materials shall be hot-dipped galvanized or metalized except those that are in contact with concrete.

823.02.2 Strip Seal Expansion Joints. The materials for the strip seal joint are the same as those set forth above in **Subsection 823.02.1**.

823.02.3 Asphaltic Expansion Joint System.

a. Backer Rod. The backer rod material shall be an expanded closed cell polyethylene foam capable of withstanding the temperature of the hot binder material, shall have a diameter 150 percent the width of the joint opening and shall have the following properties:

Density -	2.0 lbs./cu.ft. min.	ASTM D1622
Tensile Strength -	25 psi min.	ASTM D1623
Water Absorption -	1 percent of weight max.	ASTM C509

b. Binder Material. The binder material shall be a **hot applied** polymer modified bituminous material conforming to all specifications as detailed in ASTM D3405 and manufactured under strict quality control procedures as approved by the Engineer and conforming to the following:

Softening Point, (ASTM D36) - 180EF min.

c. Aggregate. The aggregate shall be of the Basalt, Gabbro or Granite groups, meeting the manufacturer's size and gradation requirements. All stones shall be double-washed, dried and delivered to the site pre-weighed in labeled packs. When tested in accordance with AASHTO T11, the material passing the #200 sieve will be no more than 0.3 percent by weight of the stone. The broadcast stone for the surface of the joint system will be basalt and shall be sized to pass the #8 sieve and be retained on the #16 sieve.

d. Steel Backing Plate. The backing plate shall conform to requirements of AASHTO M270, Grade 36 steel, minimum 1/4-inch thick and shall be galvanized in accordance with AASHTO M232. Holes for locating pins shall be approximately 1 foot center-to-center along the centerline of the plate, unless indicated otherwise on the Plans.

e. Locating Pins. Locating pins shall be 16d common nails or larger and shall be hot-dipped galvanized in accordance with ASTM A153.

f. Asphaltic Joint System. The materials for the joint system, both aggregate and binder, shall be provided by one of the manufacturers included in the Department's Approved Materials List.

823.03 CONSTRUCTION METHODS.

823.03.1 Compression Type Neoprene Deck Joints.

a. Fabrication. The steel frame shall be fabricated as detailed on the Plans. It shall be constructed to conform to roadway grade and cross slope.

b. Installation. The entire structural steel frame shall be assembled, erected and set to grade prior to placing deck (or abutment) concrete. Allowance shall be made for temperature conditions at the time of final setting. The joint assembly shall be clean and free of foreign material immediately prior to installation of the seal.

The neoprene sealer shall be installed in the field by suitable hand or machine tools and thoroughly secured in place with the approved lubricant-adhesive. The adhesive shall cover both sides of the sealer over the full contact area with the sides of the metal joint. The adhesive may be applied to the metal or the sealer or both. The sealer shall be installed in a compressed condition in the position shown on the Plans within seconds after the application of the adhesive. The sealer shall be in one piece for the full width of transverse joints. No field splicing of the seal will be permitted in transverse joints. In longitudinal joints the sealer shall be in practical lengths. Any joints in the sealer material shall be adequately sealed with additional adhesive.

c. Compliance. All sealer and adhesive to be employed in the work shall conform with the material that has been approved as the basis of test results. Each such shipment shall be identified with the manufacturer's name, address and trademark and shall be accompanied by four copies of the manufacturer's standard test results and an affidavit attesting to full compliance with these Specifications.

823.03.2 Strip Seal Expansion Joint.

a. Fabrication. The steel frame shall be fabricated as detailed on the Plans. It shall be constructed to conform to roadway grade and cross slope.

b. Installation. The entire strip seal frame shall be assembled, erected and set to grade prior to placing deck (or abutment) concrete. Allowance shall be made for temperature conditions at the time of final setting. The joint assembly shall be clean and free of foreign material immediately prior to the installation of the seal.

The neoprene strip seal shall be installed in the field by suitable hand or machine tools. The seal shall be thoroughly secured in place with the approved adhesive in accordance with the manufacturer's recommendations. The strip seal shall be in one piece for the full width of the transverse joints. No field splicing of the seal will be permitted.

c. Compliance. Compliance requirements for strip seal joints are the same as those set forth above in **Para. c** of **Subsection 823.03.1**.

823.03.3 Asphaltic Expansion Joint System.

a. Excavation. Bituminous concrete wearing surface shall be excavated from those areas where asphaltic joint material is to be placed. The joint shall be excavated by the use of saws and pneumatic hand tools. Saws shall be set to cut the full depth of the bituminous concrete and any membrane present. Variations in the thickness of the bituminous concrete across the road should be considered to insure, where possible, that the deck is not damaged.

b. Joint Preparation.

1. Cleaning. The entire joint must be thoroughly cleaned and dried using a Hot Compressed Air Lance immediately prior to tanking. All loose debris shall be removed from the gap. Care must be taken to insure that the sawcut surfaces have been thoroughly cleaned of any dust or wet paste from the cutting operation.

2. Caulking. The joint gap shall be caulked with a backer rod as shown on the Plans. It shall be placed in such a manner as to allow for the appropriate placement of the required binder material.

3. Tanking. Immediately after cleaning/caulking, the bottom of the blockout area shall be coated with a layer of hot binder that has been heated in accordance with the manufacturer's recommendations. If any delay greater than one (1) hour occurs between cleaning and tanking, the joint shall be re-cleaned using a Hot Compressed Air Lance as described above.

4. Plating. The gap shall be bridged with three-to-four foot long steel backing plates. Steel plates shall be located with pins along the centerline. The plates shall be butted to each other and shall not be overlapped. Immediately coat the walls of the blockout area and the bridging plates with binder, making sure that the plate is entirely encapsulated by the binder.

c. Asphaltic Joint Material Preparation.

1. Aggregate. The aggregate must be dried, cleaned and heated in a drum mixer by hot compressed air. The stone shall be heated to a temperature between 375°F (190°C) and the

maximum safe binder temperature as specified by the manufacturer. The temperature shall be monitored with a calibrated infrared thermometer. Under no circumstances shall the binder be mixed with the aggregate if its temperature is above the maximum. All tangible signs of dust must be removed prior to mixing of the binder with the aggregate.

2. Binder. The binder shall be heated to the manufacturer's recommended placement temperature in excess of 350°F (177°C). At no time shall the manufacturer's recommended safe heating temperature be exceeded.

d. Material Installation. The method used shall be according the manufacturer's recommended procedure. Variations from the manufacturer's procedure or from this Specification must be approved by the Engineer prior to commencement of work.

1. Placement of the Aggregate/Binder Mix into the Blockout Area. Binder material shall be added to the mixer just sufficient to thoroughly coat the aggregate. The coated aggregate shall be placed into the blockout in layers as recommended by the joint material manufacturer. The blockouts shall be overfilled with coated aggregate as required to compensate for compaction. Equipment for compaction shall be capable of sufficient compaction force as recommended by the joint manufacturer. Additional binder material shall be screeded over the compacted joint to fill any surface voids.

2. Surface Layer. Accurately measured quantities of hot aggregate shall be mixed with the binder in an unvented rotating drum mixer. The binder should be at the approved temperature to insure complete coating of all the stone. This mix shall be transferred to the joint and leveled to be slightly higher than the adjacent road surface.

3. Compaction. Compaction should take place after the joint has cooled to approximately 160°F (71°C) using a vibratory plate or roller, and the joint surface made flush with the existing road surface.

4. Screeding. Prior to the final screeding, the surface of the joint and surrounding road shall, if necessary, be dried and cleaned with a Hot Compressed Air Lance. Immediately thereafter a single screed of hot binder shall be applied to fill all surface voids.

5. Joint Sealing. The interface between the joint and the pavement shall be sealed with a 2-inch wide band of the binder, centered on the interface, for the entire length of the joint on both the leading and trailing edges, relative to traffic. The surface adjacent to the interface shall be heated with a Hot Compressed Air Lance to promote adhesion of the binder. Immediately after the application, while the binder is still hot, basalt stone shall be broadcast onto the band. It shall cover 75 percent of the surface of the band.

6. Opening to Traffic. The joint shall not be opened to traffic before the surface reaches a temperature of 120°F or 30 minutes has elapsed from placing the basalt stone.

e. Equipment. The following equipment is required for the proper installation of asphaltic bridge deck joints.

1. A manually propelled, high speed water cooled saw with diamond tipped blades capable of cutting to the full depth required in one pass.

2. A pneumatic compressor of 185 CFM capacity to power drills and breakers of various sizes with suitable size bits.

3. Two Hot Compressed Air Lances (HCA Lances), each capable of delivering a flame retarded air stream with a temperature of 3,000^{O}F (1,648^{O}C), at a speed of 3,000 feet per second. The use of a torch rather than a Hot Air Lance to heat the block out surfaces is not allowed.

4. A 200-gallon air-jacketed, trailer-mounted melter with two flame baffled L.P. ribbon type burners rated a minimum output of 175,000 BTU which shall apply indirect heat to the melting chamber. The unit shall have automatic temperature controls which can accurately maintain the material temperatures between 100°F and 650°F (38°C and 343°C). A temperature gauge, calibrated to ± 10°F of actual, must be provided and mounted such that the temperature is clearly visible to the operator and the Engineer.

The burner system shall have a safety pilot capable of shutting off the base supply in the event of a flame-out.

The melter shall be equipped with a horizontally mounted double-paddle, full sweep reversible agitation system which runs the length of the melting chamber and is driven hydraulically by a dedicated engine and compressor. Material delivery shall be by an angled 3-inch discharge port.

The electrically braked trailer shall be rated at a minimum of 6,000 pounds and shall meet all ICC regulations with regards to running lights, brake lights and stop lights.

5. Storage tanks capable of holding a minimum of 600 pounds propane, 600 pounds oxygen, and 200 pounds acetylene.

6. A dedicated drum mixer, with compressed hot air apparatus sufficient to heat the aggregate and aggregate/binder mix in the drum to the specified temperature range.

7. Acetylene cutting torches.

8. An arc welder powered by a suitable generator.

9. 500-gallon capacity water tank fitted with suitable spigots.

10. A hand-held infrared thermometer, calibrated to ±10°F.

11. A vibratory plate compactor.

12. A powered roller sufficient to span the width of the joint system in a single pass.

13. In the event of equipment failure during installation, backup equipment must be available, or in the case of a major breakdown, replacement equipment should be on site within 48 hours.

823.04 METHOD OF MEASUREMENT.

823.04.1 Compression Type Neoprene Deck Joints. "Compression Type Neoprene Deck Joints" will be measured by the number of linear feet of such joints actually installed in accordance with the Plans and/or as directed by the Engineer.

823.04.2 Strip Seal Expansion Joints. "Strip Seal Expansion Joints" will be measured by the number of linear feet of such joints actually installed in accordance with the Plans and/or as directed by the Engineer.

823.04.3 Asphaltic Expansion Joint System. "Asphaltic Expansion Joint System" will be measured by the number of linear feel of such joints actually installed in accordance with the Plans and/or as directed by the Engineer.

a. Curbs. In each of the above three statements the measured length will include the vertical rise at curbs.

823.05 BASIS OF PAYMENT.

823.05.1 Compression Type Neoprene Deck Joints. The accepted quantities of "Compression Type Neoprene Deck Joints" of various widths will be paid for at their respective contract unit prices per linear foot as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, materials and equipment, and all other incidentals required to finish the work, complete and accepted by the Engineer.

823.05.2 Strip Seal Expansion Joints. The accepted quantities of "Strip Seal Expansion Joints" of various widths will be paid for at their respective contract unit prices per linear foot as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, materials and equipment, and all other incidentals required to finish the work, complete and accepted by the Engineer.

823.05.3 Asphaltic Expansion Joint System. The accepted quantities of "Asphaltic Expansion Joint System" of various widths will be paid for at their respective contract unit prices per linear foot as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, materials, and equipment, and for all other incidentals required to finish the work, complete and accepted by the Engineer.

SECTION 824

STRUCTURAL STEEL CONSTRUCTION

824.01 DESCRIPTION. This work consists of furnishing, fabricating, and erecting all structural steel at the locations and to the details indicated on the Plans, or as directed by the Engineer, all in accordance with these Specifications. Structural steel includes, but is not limited to, carbon, special alloy steels, steel forgings, steel and iron castings and weldments.

824.01.1 Surface Preparation for Weathering Steel. This work also includes the cleaning and protection of weathering structural steel during both fabrication and after erection.

824.01.2 Applicable Specifications. In addition to this Specification, all structural steel work shall conform to the applicable requirements of the respective current editions of the AASHTO Standard Specifications for Highway Bridges and the AWS D1.5 Bridge Welding Code.

824.01.3 Related Items of Work Covered Elsewhere. Related items of work covered in other Sections of these Specifications include the following:

a. SECTION 825; PAINTING STRUCTURAL STEEL

b. SECTION 827; THERMAL SPRAYED ZINC COATING for NEW STRUCTURAL STEEL

824.01.4 Shear Connectors. This work shall consist of the provision of stud shear connectors welded to the flanges of steel beams or girders at the locations indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

a. General Requirements. Shear connector studs shall be of a design suitable for end-welding to steel beams and girders with automatically timed stud welding equipment. The type, size or diameter, and length of stud shall be as shown, specified or ordered.

Finished studs shall be of uniform quality and condition, free from injurious laps, fins, seams, cracks, twists, bends, or other injurious defects. Finish shall be as produced by cold drawing, cold rolling, or machining.

Before placing orders for studs, the Contractor shall submit to the Engineer for approval the following information on the studs to be purchased.

1. The name of the manufacturer.

2. A detailed description of the stud and arc shield to be furnished.

3. A certification from the manufacturer that the stud to be furnished is qualified in accordance with the latest AASHTO Standard Specifications for Highway Bridges.

4. If requested by the Engineer, a copy of the qualification test report as certified by the testing laboratory.

824.02 MATERIALS.

824.02.1 Structural Steels shall conform to the requirements of **Subsection M.05.04.1** of these Specifications.

824.02.2 Steel Bars and Forgings shall conform to the requirements of **Subsection M.05.04.2** of these Specifications.

824.02.3 Structural Tubing shall conform to the requirements of **Subsection M.05.04.3** of these Specifications.

824.02.4 Bolts shall conform to the requirements of **Subsection M.05.04.4** of these Specifications.

824.02.5 Weld Metal shall conform to the requirements of **Subsection M.05.04.5** of these Specifications.

824.02.6 Shear Connectors shall conform to the requirements of **Subsection M.05.04.6** of these Specifications.

824.02.7 Low Alloy Nickel Copper Steel Pipe shall conform to the requirements of **Subsection M.05.04.7** of these Specifications.

824.02.8 Steel Forging and Shafting shall conform to the requirements of **Subsection M.05.04.8** of these Specifications.

824.04.9 Steel and Iron Castings shall conform to the requirements of **Subsection M.05.04.9** of these Specifications.

824.03 CONSTRUCTION METHODS.

824.03.1 Shop Drawings. The Contractor shall prepare all shop drawings, erection diagrams, camber diagrams, and list of field rivets and bolts, from plans furnished by the State. Shop drawings and erection diagrams shall be submitted by the Contractor and reviewed by the Engineer in accordance with the requirements of **Subsection 105.02** of these Specifications.

824.03.2 Inspection and Testing.

a. Mill. The State shall be furnished complete copies of mill orders in quadruplicate. No material shall be rolled, or work done, before the Engineer has been notified where the orders have been placed so that he may arrange for the inspection.

The manufacturer shall furnish all facilities for inspecting and testing the weight and quality of all material at the mill where it is manufactured. Suitable testing equipment, properly calibrated, shall be furnished. The pieces shall be prepared for the testing machine, at no cost to the State.

Where no mill inspection is made, the Contractor shall furnish the Engineer with four copies of the mill report of chemical and physical tests prior to starting work. No markings shall be cut off until the inspector has established the heat and designation and determined the method of continued identity. Inspection and testing shall conform the **SECTION 106; CONTROL OF MATERIAL,** of these Specifications.

b. Shop. The Engineer shall be notified well in advance of the start of the work in the shop, in order that an inspector shall be on hand to inspect material and workmanship.

The fabricator shall furnish all facilities for inspecting and testing the weight and quality of workmanship at the shop where the material is fabricated. Suitable testing equipment, properly calibrated, shall be provided.

When an inspector is furnished by the State to inspect materials at the mills or at the shops, full access shall be provided at all times and to all parts of the mills or shops where the material is being manufactured or fabricated.

The inspector shall have the authority to reject any material or work which does not meet the requirements of these Specifications. In case of dispute the Contractor may appeal to the Engineer, whose decision shall be final.

The acceptance of any material or finished members by the inspectors shall not be a bar to their subsequent rejection, if subsequently found defective. Rejected material and workmanship shall be replaced promptly and made good by the Contractor.

c. Site. The Engineer may waive shop inspection and may make inspection of all fabricated material when the same is delivered at the site of the work.

The Contractor shall furnish the Engineer with a minimum of four copies of shipping statements.

The weights of the individual members shall be shown on the statement.

The Contractor shall furnish the Engineer with a Certificate of Identification as defined in Subsection 11.4.1 of the AASHTO Standard Specifications for Highway Bridges (15th Edition).

d. Delegation of Authority. The State may delegate inspection and testing to an independent laboratory or testing company. This agency shall have all the prerogatives as previously mentioned for the Engineer except that in the event of a disagreement of substance the Contractor may appeal a decision to the Engineer whose decision shall be final.

824.03.3 Fabrication.

a. Quality of Workmanship. Workmanship and finish shall be equal to the best general practice of modern bridge shops.

b. Shop Storage of Materials. Structural material, either plain or fabricated, shall be stored at the bridge shop above the ground upon platforms, skids, or other supports. It shall be kept free from dirt, grease and other foreign matter, and shall be protected as far as practicable from corrosion.

c. Holes for High-Strength Bolts and Unfinished Bolts.

1. General. All holes for bolts shall be either punched or drilled. Material forming parts of a member composed of not more than five thicknesses of metal may be punched 1/16-inch larger than the nominal diameter of the bolts whenever the thickness of the material is not greater than 3/4-inch for structural steel, 5/8-inch for high-strength steel of ½-inch for quenched and tempered alloy steel.

When there are more than five thicknesses or when any of the main material is thicker than 3/4-inch for structural steel, 5/8-inch for high-strength steel, or ½-inch for quenched and tempered alloy steel, all holes shall either be subdrilled and reamed or drilled full size.

When required, all holes shall be either subpunched or subdrilled (subdrilled if thickness limitation governs) 3/16-inch smaller and, after assembling, reamed 1/16-inch larger or drilled full size to 1/16-inch larger than the nominal diameter of the bolts.

When shown on the Plans, enlarged or slotted holes are allowed with high-strength bolts.

2. Punched Holes. The diameter of the die shall not exceed the diameter of the punch by more than 1/16-inch. If any holes must be enlarged to admit the bolts, such holes shall be reamed. Holes must be clean cut without torn or ragged edges.

3. Reamed or Drilled Holes. Reamed or drilled holes shall be cylindrical, perpendicular to the member, and shall comply with the requirements of **Para. c.1**, above, as to size. Where practical, reamers shall be directed by mechanical means. Burrs on the outside surfaces shall be removed. Reaming and drilling shall be done with twist drills, twist reamers or rotobroach cutters. Connecting parts requiring reamed or drilled holes shall be assembled and securely held while being reamed or drilled and shall be match marked before disassembling.

4. Accuracy of Holes. Holes not more than 1/32-inch larger in diameter than the true decimal equivalent of the nominal diameter that may result from a drill or reamer of the nominal diameter are considered acceptable, the slightly conical hole that naturally results from punching operations is considered acceptable. The width of slotted holes which are produced by flame cutting or a combination of drilling or punching and flame cutting shall generally be not more than 1/32-inch greater than the nominal width. The flame cut surface shall be ground smooth.

d. Accuracy of Hole Group.

1. Accuracy Before Reaming. All holes punched full size, subpunched, or subdrilled shall be so accurately punched that after assembling (before any reaming is done) a cylindrical pin 1/8-inch smaller in diameter than the nominal size of the punched hole may be entered perpendicular to the face of the member, without drifting, in at least 75 percent of the contiguous holes in the same plane. If the requirement is not fulfilled, the badly punched pieces will be rejected. If any hole will not pass a pin 3/16-inch smaller in diameter than the nominal size of the punched hole, this will be cause for rejection.

2. Accuracy After Reaming. When holes are reamed or drilled, 85 percent of the holes in any contiguous group shall, after reaming or drilling, show no offset greater than 1/32-inch between adjacent thicknesses of metal.

All steel templates shall have hardened steel bushings in holes accurately dimensioned from the centerlines of the connection as inscribed on the template. The centerlines shall be used in locating accurately the template from the milled or scribed ends of the members.

e. Holes for Ribbed Bolts, Turned Bolts, or Other Approved Bearing-Type Bolts. All holes for ribbed bolts, turned bolts, or other approved bearing-type bolts shall be subpunched or subdrilled 3/16-inch smaller than the nominal diameter of the bolt and reamed when assembled, or drilled to a steel template or, after assembling, drilled from the solid at the option of the fabricator. In any case the finished holes shall provide a driving fit as specified on the Plans or in the Special Provisions.

f. Preparation of Field Connections. Holes in all field connections and field splices of main members of trusses, arches, continuous bean spans, bents, towers (each face), plate girders, and rigid frames shall be subpunched or subdrilled and subsequently reamed while assembled or drilled full size to a steel template. Holes for field splices of rolled beam stringers continuous over floor beams or cross frames may be drilled full size unassembled to a steel template. All holes for floor beams or cross frames may be drilled full size unassembled to a steel template. All holes for floor beam and stringer field end connections shall be subpunched and reamed while assembled or drilled full size to a steel template. Reaming or drilling full size of field connection holes through a steel template shall be done after the template has been located with utmost care as to position and angle and firmly bolted in place. Templates used for reaming matching members, or the opposite faces of a single member, shall be exact duplicates. Templates used for connections on like parts or members shall be so accurately located that the parts or members are duplicates and require no match-marking.

For any connection, in lieu of subpunching and reaming or subdrilling and reaming, the fabricator may, at his option, drill holes full size with all thicknesses or material assembled in proper position.

824.03.4 Bolts and Bolted Connections Using Unfinished, Turned and Ribbed Bolts.

a. General. Bolts shall be unfinished, turned or an approved form of ribbed bolts as designed. Bolts shall have hexagonal heads and nuts and shall be of such length that they will extend entirely thorough the nut but not more than 1/4-inch beyond.

Beveled washers shall be used where bearing faces have a slope of more than 1:20 with respect to a plane normal to the bolt axis. Bolts shall have single self-locking nuts or double nuts.

b. Unfinished Bolts. Bolts in shear shall have not more than one thread within the grip. The diameter of the unfinished bolt shall be not more than 1/16-inch smaller than the diameter of the hole.

c. Turned Bolts. Holes for turned bolts shall be carefully reamed and the bolts turned to a light driving fit, with threads entirely outside of holes, and a washer shall be used. One-quarter inch nut locks shall be used on all turned bolts unless otherwise specified on the Plans.

d. Ribbed Bolts. Special types of ribbed bolts, with drive fit, may be used if approved by the Engineer in writing, for special purposes or for field rivets in locations where, in the opinion of the Engineer, it is impractical to drive rivets. In the event that the bolt twists before drawing tight, it shall be removed, the hole rereamed and an oversize bolt used in replacement.

824.03.5 Connections Using High Strength Bolts.

a. General. This Subsection covers the assembly of structural joints using ASTM A325 high strength carbon steel bolts or equivalent fasteners, tightened to a high tension. The bolts are used in holes conforming to the requirements of **Subsection 824.03.3** of this Section.

b. Bolts, Nuts and Washers. Bolts, nuts and washers shall conform to the requirements of **Subsection M.05.04.4; Fasteners,** of these Specifications.

c. Bolted Parts. The slope of surfaces of bolted parts in contact with the bolt head and nut shall not exceed 1:20 with respect to a plane normal to the bolt axis. Bolted parts shall fit solidly together when assembled and shall not be separated by gaskets or any other interposed compressible material.

When assembled, all joint surfaces, including those adjacent to the bolt heads, nuts or washers, shall be free of scale, except tight mill scale, and shall also be free of dirt, loose scale, burrs, other foreign material and other defects that would prevent solid seating of the parts.

Contact surfaces within friction-type joints shall be free of oil, paint, lacquer, rust inhibitor or galvanizing.

d. Installation. Each fastener shall be tightened to provide, when all fasteners in the joint are tight, at least the minimum bolt tension shown on the Bolt Tension Table in **Para. g** of this Subsection.

Threaded bolts shall be tightened with properly calibrated wrenches or by the turn-of-the nut method. If required because of bolt entering and wrench operation clearances, tightening by either procedure may be done by turning the bolt while the nut is prevented from rotating.

Impact wrenches, if used, shall be of adequate capacity and sufficiently supplied with air (minimum 100 psi at tool for 7/8-inch bolts) to perform the required tightening of each bolt in approximately ten seconds.

e. Washers. All fasteners shall have a hardened washer under the element (nut or bolt head) turned in tightening.

Where an outer face of the bolted parts has a slope of more than 1:20 with respect to a plane normal to the bolt axis, a smooth beveled washer shall be used to compensate for the lack of parallelism.

On diaphragm connections using oversized holes, a washer must be used over every oversized hole regardless of part turned in tightening.

f. Calibrated Wrench Tightening. Calibrated wrench tightening may be used only when installation procedures are calibrated on a daily basis and when a hardened washer is used under the element turned in tightening. Standard torques determined from tables or from formulas which are assumed to relate torque to tension are not acceptable.

When calibrated wrenches are used for installation they shall be set to provide a tension not less than 5 percent in excess of the minimum tension specified in the Bolt Tension Table in **Para. g** of this Subsection. The installation procedures shall be calibrated by verification testing at least once each working day for each bolt diameter, length and grade using fastener assemblies that are being installed in the work. This verification testing shall be accomplished in a device capable of indicating actual bolt tension by tightening three typical bolts of each diameter, length and grade from the bolts being installed and with a hardened washer from the washers being used in the work under the element turned in tightening. Wrenches shall be recalibrated when significant difference is noted in the surface condition of the bolts, threads, nuts or washers. It shall be verified during actual installation in the assembled steel work that the wrench adjustment selected by the calibration does not produce a nut or bolt head rotation from

snug tight greater than that permitted in the Nut Rotation Table in **Para. g** of this Section. If manual torque wrenches are used, nuts shall be turned in the tightening direction when torque is measured.

When calibrated wrenches are used to install and tension bolts in a connection, bolts shall be installed with hardened washers under the element turned in tightening bolts in all holes of the connection and brought to a snug tight condition. Following this initial tightening operation, the connection shall be tightened using the calibrated wrench. Tightening shall progress systematically from the most rigid part of the joint to its free edges. The wrench shall be returned to "touch up" previously tightened bolts which may have been relaxed as a result of the subsequent tightening of adjacent bolts until all bolts are tightened to the prescribed amount.

g. Turn-of-Nut Tightening. Verification testing using a representative sample of not less than three bolt and nut assemblies of each diameter, length and grade to be used in the work shall be performed at the start of work in a device capable of indicating bolt tension. This verification test shall demonstrate that the method for estimating the snug tight condition and controlling the turns from snug tight to be used by the bolting crew develops a tension not less than 5 percent greater than the tension required by the Bolt Tension Table. Periodic retesting shall be performed when ordered by the Engineer.

After snug tightening fasteners and fully compacting the connection, all bolts in the connection shall be tightened further by the applicable amount of rotation specified in the Nut Rotation Table. During the tightening operation there shall be no rotation of the part not turned by the wrench. Tightening shall progress systematically from the most rigid part of the joint to its free edges.

Bolt Tension Table
Minimum Bolt Tension in Pounds *

Bolt Size, in Inches	A325 Bolts
½	12000
5/8	19000
3/4	28000
7/8	39000
1	51000
1⅛	56000
1¼	71000
1⅜	85000
1½	103000

* Equal to 70 percent of specified minimum tensile strength of bolts (as specified in ASTM Specifications for tests of full-size A325 bolts with UNC threads loaded in axial tension) rounded to the nearest kip.

Nut Rotation Table

Nut Rotation from the Snug-Tight Condition [a,b] Geometry of Outer Faces of Bolted Parts

Bolt length measured from underside of head to end of bolt.	Both faces normal to bolt axis.	One face normal to bolt axis and other face sloped not more than 1:20. Bevel washer not used.	Both faces sloped not more than 1:20 from normal to bolt axis. Bevel washers not used.
Up to and including 4 diameters	1/3 turn	½ turn	2/3 turn
Over 4 diameters but not exceeding 8 diameters	½ turn	2/3 turn	5/6 turn
Over 8 diameters but not exceeding 12 diameters [c]	2/3 turn	5/6 turn	1 turn

Notes:

a Nut rotation is relative to bolt, regardless of the element (nut or bolt) being turned. For bolts installed by ½ turn and less, the tolerance should be plus or minus 30 degrees; for bolts installed by 2/3 turn and more, the tolerance should be plus or minus 45 degrees.

b Applicable only to connections in which all material within grip of the bolt is steel.

c No research work has been performed by the Research Council Riveted and Bolted Structural Joints to establish the turn-of-nut procedure when bolt lengths exceed 12 diameters. Therefore, the required rotation must be determined by actual tests in a suitable tension device simulating the actual conditions.

h. Inspection. The Engineer will determine that all requirements of this Specification are satisfied.

The Engineer will approve the procedure for calibration of wrenches and installation of bolts and will further observe the field installation to determine that these procedures are followed.

Spot checks will be made with a manual torque wrench that has been calibrated as previously specified.

i. Load Indicator Devices. Load indicating devices may be used in conjunction with bolts, nuts and washers specified in **Subsection M.05.04.4.** Load indicating devices shall conform to the requirements of ASTM Specification for Compressible-Washer Type Direct

Tension Indicators for Use with Structural Fasteners, ASTM F959, except as provided in the following paragraph.

Subject to the approval of the Engineer, alternate design direct tension indicating devices may be used provided they satisfy the requirements detailed in specifications provided by the manufacturer.

824.03.6 Welding.

a. General. Unless specified otherwise herein, all welding, welder qualifications, prequalification of weld details and inspection of welds shall conform to the requirements of the current ANSI/AASHTO/AWS D1.5 Bridge Welding Code.

Brackets, clips, shipping devices or other material not required by the Plans or Special Provisions shall not be welded or tacked to any member unless shown on the shop drawings and approved by the Engineer.

b. Qualification of Welders. All work shall be in accordance with the best modern practice using qualified welding operators. The same type of equipment as required for the execution of the actual construction work shall be used in qualifying welders and welding operators.

If the Contractor prequalifies his metal-arc welding operators according to the standard qualification procedure of the American Welding Society and certifies to the Engineer that an operator working on the structure has been prequalified previously, the Engineer may consider such operator qualified. This certificate shall state that such operator has been doing satisfactory welding of the required type within the 3-month period previous to the subject work. A certification shall be submitted for each operator and for each project, stating the name of the operator, the name and title of the person who conducted the examination, the kind of specimens, the positions of welds, the results of the test, the date of the examination and the identifying steel stamp symbol assigned. Such a certification of prequalification may also be accepted as proof that an operator of field welding is qualified, if the Contractor who submits it is properly staffed and equipped to conduct such an examination, or if the examining and testing is done by a recognized agency which is staffed and equipped for such purpose. The qualification of a welder shall not prohibit his subsequent removal from the job for poor workmanship in execution of welds.

The welder shall place his identification stamp near the welds that he has made.

Shop welding shall be done in areas sheltered from wind and weather with an ambient minimum temperature of 50°F, unless otherwise permitted by the Engineer.

c. Qualification of Welding Procedure. The Contractor shall submit a complete welding procedure specification for welding all primary members and other members on which welds are subject to calculated stress prior to proceeding with fabrication.

d. Procedures for Manual Shielded Metal-Arc Welding. The work shall be positioned for flat position welding whenever practicable.

824.03.7 Inspection of Welds.

a. General. All welding, both shop and field, shall be subject to inspection by the Engineer, in accordance with ANSI/AASHTO/AWS D1.5 Bridge Welding Code, as amended herein. The principal method of inspection shall be non-destructive testing, which may be carried out by radiographic, magnetic particle, dye penetrant or ultrasonic methods, or any other methods designated by the Engineer. A minimum routine inspection program is outlined in TABLE 1. However, inspection shall in no way be construed to be limited to the program described.

A routine inspection program shall be established to which all welding shall be subject. This program shall involve two types of inspection.

b. Visual Inspection of Welds and Welding Operations. The Engineer shall have unlimited access to the site of welding operations, and shall be free to observe the procedure and techniques used by the Contractor on all welds. The program of visual inspection will be adapted to job conditions. The cost of visual inspection shall be borne by the State.

c. Non-destructive Testing. A routine program of non-destructive testing will be carried out on all welds (shop and field) carrying calculated stress as indicated in Table 1 of this Subsection.

All non-destructive testing will be performed by the State, except that the Contractor shall, at his own expense, radiograph and furnish the State one set of films of shop butt welds above specified and shall furnish all equipment and an operator at his own expense for the making of magnetic particle tests of shop fillet welds as above specified. All other costs of non-destructive inspection shall be borne by the State except that the Contractor shall furnish all labor and equipment required to move and position the various members for inspection. No additional compensation shall be granted to the Contractor for moving, handling, rehandling or positioning the members to facilitate testing.

TABLE 1: NON-DESTRUCTIVE TESTING PROGRAM

Type of Weld	Percentage (Number, Quantity) of Weld(s) to be tested	Inspection	Remarks
Flange to flange butt welds-tension	100%	Radiographic	
Flange to flange butt welds-compression	50% (selected at random by the Engineer)	Radiographic	If any radiographed joint is rejected, all compression grooved welds of this member shall be radiographed 100%.
Web to web butt welds	One-third of depth closest to tension flange of each weld	Radiographic	If quality of the portion radiographed is unsatisfactory, entire weld shall be radiographed.
Flange plate to cover plate fillet weld	10% (each end of each weld and other locations to be selected at random by the Engineer)	Approved magnetic particle	Quantity of weld to be inspected shall be increased if quality of initially inspected weld proves unsatisfactory. (See AWS D.2.0. as amended by Circular Memo.)
Flange to web fillet welds	10% (each end of each weld and other locations to be selected at random by the Engineer)	Approved magnetic particle	Quantity of weld to be inspected shall be increased if quality of initially inspected weld proves unsatisfactory. (See AWS D.2.0 as amended by Circular Memo.)
Repair of flame cut edge with greater than 3/16" gouge.	100%	Radiographic	Radiographing and laboratory report at expense of fabricator.

824.03.8 Machining.

a. Edge Planing. Sheared edges of plates more than 5/8-inch in thickness and carrying calculated stress shall be planed to a depth of 1/4-inch. Re-entrant cuts shall be filleted before cutting.

b. Oxygen Cutting. Steel and weld metal may be oxygen cut, provided a smooth and regular surface free from cracks and notches is secured, and provided that an accurate profile is secured by the use of a mechanical guide. Hand cutting shall be done only where approved by the Engineer.

Mill scale and extraneous material shall be removed from the torch side of A514/A517 steel plates along the lines to be flame cut, when necessary to obviate excessive notches.

All oxygen cutting shall be in accordance with AWS D.1.5, except that occasional notches or gouges in edges of A514/A517 steel shall not be repaired by welding except under the following conditions:

1. Cutting defects not more than 3/16-inch deep in plate edges which will form the faces of a groove weld joint and which will subsequently be completely fused with the weld may be repaired by welding. Nonmetallic stringers or pipes opening to these edges shall be removed to a depth of 1/4-inch below the surface by grinding or chipping and the gouge repaired by welding. Laminations opening to these edges shall be removed to a depth of ½-inch below the surface by grinding and chipping and the gouge repaired by welding.

2. Cutting defects not more than 3/16-inch deep in plate edges which will form a fillet-welded corner joint shall be repaired by welding only on the part of the edge which will become the facing surface for the joint and the fusion zone of the fillet weld. The part of the defect outside the toe of the completed fillet weld shall be removed by machining or grinding, and faired with the surface of the cut on a bevel of 1 to 6 or less.

3. All welding for these repairs shall be made by suitably preparing the defect, welding with low hydrogen electrodes not exceeding 5/32-inch in diameter, and grinding the completed weld smooth and flush with the adjacent surface to produce a workmanlike finish.

Oxygen cut edges of ASTM A440 steel and ½-inch or greater in thickness[(1)] shall be removed to a depth of at least 1/8-inch by machining or grinding except that machine flame cut edges may be used without such removal if the edges are softened after cutting; (a) by heating the cut edge uniformly and progressively to a red heat, visible in ordinary shop light (1,150 to 1,250^{O}F) to a depth of at least 1/16-inch; or (b) by means of a post heating torch attached to and following the cutting torch with the tips, gas pressure, speed or travel, and the distance of the post heating torch from the kerf regulated to the thickness of the steel. Bend test specimens 1½-inches wide and of the full thickness of the material or with thickness reduced to 3/4-inch in accordance with Para. 6.8 of ASTM A6 and having edges flame cut and flame softened in accordance with this article shall meet the bend test requirements specified in ASTM A440 for the thickness of material under consideration.

Oxygen cut surfaces of members carrying calculated stress shall have their corners rounded to 1/16-inch radius by grinding after cutting.

Note [1]: ASTM A242 steel not approved for welded construction requires this treatment of oxygen cut edges in all thicknesses and with bend tests, as applicable, conforming to ASTM A242 for the thickness of material under consideration.

c. Facing of Bearing Surfaces. The top and bottom surfaces of steel slabs and base plates and cap plates of columns and pedestals shall be straight and true to provide full bearing between contact areas.

Sole plates of beams and girders shall have full contact with the flanges. Cast pedestals shall be machined on surfaces to be in contact with steel and shall be rough finished on surfaces to be in contact with masonry.

Surfaces of bronze bearing plates intended for sliding contact shall be finished. The surface of expansion bearings shall be machined in the direction of the major expansion.

The surface finish of bearing and base plates and other bearing surfaces that are to come in contact with each other or with concrete shall meet the ANSI surface roughness requirements as defined in ANSI B46.1, Surface Roughness, Waviness and Lay, Part I:

Bearing Surfaces	**Roughness Requirements**
Steel slabs	ANSI 2,000
Heavy plates in contact in shoes to be welded	ANSI 1,000
Milled ends of compression members, milled or ground ends of stiffeners and fillers	ANSI 500
Bridge rollers and rockers	ANSI 250
Pins and pin holes	ANSI 125
Sliding bearings	ANSI 125

d. Abutting Joints. Abutting joints in compression members and girder flanges, and in tension members where so specified on the drawings, shall be faced and brought to an even bearing. Where joints are not faced, the opening shall not exceed 3/8-inch.

e. End Connection Angles. Floor beams, stringers and girders having end connection angles shall be built to exact length back to back of connection angles. If end connections are faced, the finished thickness of the angles shall not be less than that shown on the detail drawings.

f. Pins and Rollers. Pins and rollers shall be accurately turned to the dimensions shown on the drawings and shall be straight, smooth and free from flaws. The final surface shall be produced by a fine finishing cut as specified. Pin holes shall be bored true to the specified diameter, smooth and straight, at right angles with the axis of the completed member. The distance outside to outside of holes in tension members and inside to inside of holes in compression members shall not vary from that specified more than 1/32-inch. Boring of holes in built-up members shall be done after the riveting and welding is completed. The diameter of the pin hole shall not exceed that of the pin by more than 1/50-inch for pins 5 inches or less in diameter, or 1/32-inch for pins of larger size.

Threads for all bolts and pins for structural steel construction shall conform to the American National Coarse Thread Series, Class 2, free fit, except that the pin ends having a diameter of 1⅜-inches or more shall be threaded six threads to the inch.

Finished members shall be true to line and free from twists, bends and open joints. Shearing and chipping shall be done carefully and accurately.

g. Fit of Stiffeners. End stiffeners, stiffeners over intermediate supports of girders, and stiffener angles intended as supports for concentrated loads shall be milled or ground to secure an even bearing against the flange. Intermediate stiffeners shall fit sufficiently tight to exclude water after being painted. Fillers under stiffeners shall fit within 1/4-inch at each end.

h. Annealing and Stress Relieving. Structural members which are indicated in the Contract to be annealed or normalized shall have finished machining, boring, and straightening done subsequent to heat treatment. Normalizing and annealing (full annealing) shall be as specified in ASTM E44. The temperatures shall be maintained uniformly throughout the furnace during the heating and cooling so that the temperature at no two points on the member will differ by more than 100°F at any one time.

Members of AASHTO M270 (ASTM A709) Grades 100/100W or Grade 70W steels shall not be annealed or normalized and shall be stress relieved only with the approval of the Engineer.

A record of each furnace charge shall identify the pieces in the charge and show the temperatures and schedule actually used. Proper instruments, including recording pyrometers, shall be provided for determining at any time the temperatures of members in the furnace. The records of the treatment operation shall be available to and meet the approval of the Engineer. The holding temperature for stress relieving Grades 100/100W and Grade 70W steels shall not exceed 1100°F and 1050°F, respectively.

Members, such as bridge shoes, pedestals, or other parts which are built up by the welding sections of plate together shall be stress-relieved in accordance with the procedure of the American Welding Society Section 4.4 of the current ANSI/AASHTO/AWS D1.5 Bridge Welding Code when required by the Plans or Specifications.

824.03.9 Marking, Shipping, Delivering and Handling. Each member shall be painted or marked with an erection mark for identification and an erection diagram showing these marks shall be furnished to the Engineer.

The Contractor shall furnish to the Engineer as many copies of material orders, shipping statements, and erection diagrams as the Engineer may direct. The weights of the individual members shall be shown on the statements. Members weighing more than 3 tons shall have the weights marked thereon. Structural members shall be loaded on trucks or cars in such a manner that they may be transported and unloaded at their destination without being excessively stressed, deformed, or otherwise damaged.

Bolts, nuts and washers (where required) from each rotational-capacity lot shall be shipped in the same container. If there is only one production lot number for each size of nut and washer, the nuts and washers may be shipped in separate containers. Pins, small parts and packages of bolts, washers, and nuts shall be shipped in boxes, crates, kegs, or barrels, but the gross weight of any package shall not exceed 300 pounds. A list and description of the contained materials shall be plainly marked on the outside of each shipping container.

The loading and delivery of the structural material shall be conducted so that the metal will be kept clean and free from injury. Girders and beams shall be kept upright and shored. Long members shall be supported on skids spaced to prevent injury from deflection.

824.03.10 Erection.

a. General. The Contractor shall provide the falsework and all tools, machinery and appliances, including drift pins and fitting bolts necessary for the expeditious handling of the work. Before starting work, the Contractor shall inform the Engineer fully as to the method of erection he proposes to follow, and the amount and character of equipment he proposes to use, all of which shall be subject to the approval of the Engineer. The approval of the Engineer shall not be considered as relieving the Contractor of the responsibility for the safety of his method or equipment or from carrying out the work in full accordance with the Plans and these Specifications.

b. Transportation of Materials. The Contractor shall make the necessary arrangements for the unloading and the transporting and bear all charges for such unloading and hauling of the steel from the designated place of delivery to the point of placement. The Contractor shall unload promptly upon delivery any material delivered on railroad cars which he is required to unload, and shall be responsible for demurrage charges.

c. Storage of Materials at Site. Material to be stored shall be placed on skids above the ground. It shall be kept clean and properly drained. Girders and beams shall be placed upright and shored. Long members, such as columns and chords, shall be supported on skids placed near enough together to prevent injury from deflection. If the contract is for erection only, the Contractor shall check the material turned over to him against the shipping lists and report promptly in writing any shortage or injury discovered. The Contractor shall be responsible for the loss of any material while in his care, or for any damage caused to it after being received by him.

d. Falsework. The falsework shall be properly designed and substantially constructed and maintained for the loads which will come upon it. The Contractor shall prepare and submit to the Engineer for approval, plans for falsework or for changes in an existing structure necessary for maintaining traffic. Approval of the Contractor's plans shall not be considered as relieving the Contractor of his primary responsibility for the adequacy of the design.

e. Straightening Bent Material (Field). The straightening of plates, angles, other shapes, and built-up members, when permitted by the Engineer, shall be done by methods that will not produce fracture or other injury to the metal. Distorted members shall be straightened by mechanical means or, if approved by the Engineer, by carefully planned procedures and supervised application of a limited amount of localized heat, except that heat straightening of AASHTO M270 (ASTM A709) Grades 70W, 100 and 100W steel members shall be done only under rigidly controlled procedures, with each application subject to the approval of the Engineer. In no case shall the maximum temperature exceed values in the following table.

Grade	Max. Temp.
Grade 70W > 6" from weld	1050°F
Grade 70W < 6" from weld	900°F
Grade 100 or 100W > 6" from weld	1100°F
Grade 100 or 100W < 6" from weld	950°F

In all other steels, the temperature of the heated area shall not exceed 1,200^{O}F as controlled by temperature indicating crayons, liquids, or bimetal thermometers. Heating in excess of the limits shown shall be cause for rejection, unless the Engineer allows testing to verify material integrity.

Parts to be heat straightened shall be substantially free of stress and from external forces, except stresses resulting from mechanical means used in conjunction with the application of heat.

Evidence of fracture following straightening of a bend or buckle will be cause for rejection of the damaged piece.

f. Assembling Steel. The parts shall be accurately assembled as shown on the Plans and any match-marks shall be followed. The materials shall be carefully handled so that no parts will be bent, broken or otherwise damaged. Hammering which will injure or distort the members shall not be done. Bearing surfaces and surfaces to be in permanent contact shall be cleaned before the members are assembled. Splices and field connections shall have one-half of the holes filled with bolts and cylindrical pins (half bolts and half pins) before riveting.

Fitting-up bolts shall be of the same nominal diameter as the rivets, and cylindrical erection pins shall be 1/32-inch larger.

g. Bolted Connections. Surfaces of metal in contact shall be cleaned before assembling. The parts of a member shall be assembled, well pinned, and firmly drawn together before drilling, reaming, or bolting is commenced. Assembled pieces shall be taken apart, if necessary, for the removal of burrs and shavings produced by the operation. The member shall be free from twists, bends, and other deformation.

The drifting done during assembling shall be only such as to bring the parts into position and not sufficient to enlarge the holes or distort the metal.

For high-strength bolted connections, see **Subsection 824.03.5** of this Section.

h. Field Welding. When field welding is specified, it shall be performed by the electric arc process and shall conform to the same requirements as noted under **Subsection 824.03.6** with the following modifications:

Unless approved by the Engineer, welding shall not be undertaken when the ambient temperature is lower than 32°F, when surfaces are wet or exposed to rain, snow or high wind nor when the welders would be exposed to inclement conditions.

i. Misfits. The correction of minor misfits involving non-harmful amounts of reaming, cutting and chipping will be considered a legitimate part of the erection. However, any error in the shop fabrication or deformation resulting from handling and transportation which prevents the proper assembling and fitting up of parts by the moderate use of drift pins or by a moderate amount of reaming and slight chipping or cutting, shall be reported immediately to the Inspector and his approval of the method of correction obtained. The correction shall be made in his presence. The Contractor shall be responsible for all misfits, errors and injuries and shall make all the necessary corrections and replacements.

j. Removal of Falsework. Upon completion of the erection and before final acceptance, the Contractor shall remove all falsework, excavated or useless materials, rubbish and temporary buildings and restore in an acceptable manner all property, both public and private which may have been damaged during the prosecution of this work, and shall leave the bridge site and adjacent highway in a neat and presentable condition satisfactory to the Engineer.

824.03.11 Surface Preparation for Weathering Steel.

a. Cleaning After Fabrication. After completion of fabrication operations all steel surfaces shall be blast cleaned in accordance with the requirements of Steel Structures Painting Council Surface Preparation Specification No. 6 - "Commercial Blast Cleaning," SSPC-SP 6. Particular attention shall be given to all exposed surfaces including the outside face and bottom side of fascia girders and all exposed fascia welds.

b. Handling. All cleaned steel is to be handled carefully to keep it clean. The steel is to be treated with the care and concern that is required for any finished architectural product. Exposed steel shall be kept free and clean of all foreign material such as grease, oil, concrete spatter, chalk marks, crayon marks, dirt, etc. Natural oxidation of the steel shall not be considered foreign matter.

c. Final Cleaning. After the deck is in place and all formwork has been removed the steel surfaces shall be inspected for stains, discoloration, and any other deleterious materials which may affect the weathering of the steel in a uniform manner. All steel surfaces, in particular exposed steel surfaces as described above, shall be returned to the SP 6, "Commercial Blast Cleaned" finish. The Contractor shall use whatever Steel Structures Painting Council Surface Cleaning Methods are necessary and appropriate to accomplish that goal. Once the final cleaning is accomplished no further use of the structural steel for attachment or support will be allowed.

824.03.12 Shear Connectors.

a. Welding. Stud shear connectors shall be end-welded to steel beams or girders (on axes parallel to the transverse reinforcement) with automatically timed stud welding equipment connected to a suitable power source.

If two or more stud welding guns are to be operated from the same power source, they shall be interlocked so that only one gun can operate at a time and so that the power source has fully recovered from making one weld before another weld is started.

At the time of welding, the studs and beams shall be free from moisture, rust, rust pits, scale, oil or other deleterious matter which would adversely affect the welding operation.

Welding shall not be done when the ambient temperature is below 32°F, or when the surface is wet or exposed to rain or snow.

While in operation, the welding gun shall be held in position without movement until the weld metal has solidified.

Longitudinal and lateral spacings of studs with respect to each other and to edges of beam or girder flanges shall not vary more than one-half inch from the dimensions shown on the Plans, except that a diagonal variation of 1 inch will be permitted where required to avoid obstruction

with other attachments on the beam or where a new stud is being welded to replace a defective one. The minimum distance from the edge of a stud to the edge of a beam shall be 1 inch, but preferably not less than 1½-inches.

The first two studs welded on each beam or girder, after being allowed to cool, shall be bent 45° by striking the stud with a hammer. If failure occurs in the weld of either stud, the procedure shall be corrected and two successive studs successfully welded and tested before any more studs are welded to the beam or girder. The Engineer shall be promptly informed of any changes in the welding procedure at any time during construction.

If the reduction in the height of studs as they are welded becomes less than normal, welding shall be stopped immediately and not resumed until the cause has been corrected.

Before welding a new stud where a defective one has been removed, the area shall be ground smooth and flush, or in the case of a pullout of metal, the pocket shall be filled with weld metal using the shielded metal-arc process with low-hydrogen welding electrodes and then ground flush. In compression areas of flanges, a new stud may be welded adjacent to the defective area in lieu of repair and replacement on the existing weld area.

b. Inspection. If visual inspection reveals any stud which does not show a full 360-degree weld, any stud which has been repaired by welding, or any stud in which the reduction in height due to welding is less than normal, such stud shall be struck with a hammer and bent 15 degrees off the vertical. For studs showing less than 360-degree weld, the direction of bending shall be opposite to the lack of weld. Studs that crack either in the weld or the shank shall be replaced.

The Engineer may select additional studs to be subjected to the bend test specified above.

The studs tested that show no sign of failure may be left in the bent position.

If, during the progress of the work, inspection and testing indicate in the judgment of the Engineer, that the shear connectors being obtained are not satisfactory, the Contractor will be required at his expense to make such changes in welding procedure, welding equipment and type of shear connector as necessary to secure satisfactory results.

At the option of the Engineer, the manufacturer of the studs may be required at any time to submit requalification test data in accordance with the procedure as set forth in AASHTO Standard Specifications for Highway Bridges.

824.04 METHOD OF MEASUREMENT.

824.04.1 General. "Structural Steel" of the various types and configurations described in this Section will be measured by the number of pounds of each such type and configuration actually provided in accordance with the Plans and/or as directed by the Engineer.

For the purpose of measurement, such items as castings, forgings, wrought iron, special alloy steels, weld metal and special shapes for expansion joints, shear connectors, drainage fixtures, or railing shall, unless otherwise covered by Special Provisions, be considered as structural steel even when made of other materials.

824.04.2 Unit Weights. The weight of metal shall be computed on the basis of the following unit weights expressed in pounds per cubic foot:

Metal	Unit Weights
Aluminum, cast or rolled	173.0
Bronze or copper alloy	536.0
Copper, sheet	558.0
Iron, cast	445.0
Iron, wrought	487.0
Iron, malleable	470.0
Lead, sheet	707.0
Steel, cast or rolled, including alloys, copper bearing and stainless	490.0
Zinc	450.0

a. Estimated Overrun. The weights of steel shapes and plates shall be computed on the basis of their nominal weights and dimensions as shown on the approved shop drawings and after deducting for open holes. To the nominal theoretical weight of all universal mill and sheared plates and slabs, there shall be added an estimated overrun computed as one-half the "Permissible Variation in Thickness and Weight" as tabulated in ASTM A6.

b. High Strength Bolts. The weight of high strength bolt heads and nuts shall be included on the basis of the following weights:

Diameter of Bolt in Inches	Weight per 100 Bolts in Pounds
½	19.7
5/8	31.7
3/4	52.4
7/8	80.4
1	116.7
1⅛	165.1
1¼	212.0
1⅜	280.0
1½	340.0

c. Weld Metal. The weight of weld metal to the net length called for on the drawings shall be included based on the following table:

Size of Fillet in Inches	Weight in Pounds per Foot of Weld
3/16	.08
1/4	.14
5/16	.22
3/8	.30
½	.55
5/8	.80
3/4	1.10
7/8	1.50
1	2.00

If the Contract does not include erection by the fabricator, field welds shall not be included.

The weight of temporary erection bolts, shop and field paint, galvanizing and material used for shipping and erection shall not be included.

d. Castings. The weight of castings shall be computed from the dimensions shown on the approved shop drawings, deducting for open holes. To the weight will be added a 5 percent allowance for fillets and overrun. Scale weights may be substituted for computed weights in the case of castings or of small complex parts for which accurate computation of weights would be difficult.

824.04.3 Surface Preparation for Weathering Steel. This work will not be measured separately for payment.

824.04.4 Shear Connectors. “Welded Stud Shear Connectors” will be measured by the number of each such piece actually welded to steel flanges in accordance with the Plans and/or as directed by the Engineer.

824.05 BASIS OF PAYMENT.

824.05.1 Structural Steel; Furnish, Fabricate and Erect. The accepted quantity of "Structural Steel; Furnish, Fabricate and Erect" will be paid for at the contract unit price per pound as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, and equipment, including fabricating, delivering, erecting, shop and field painting unless specified otherwise, and all other incidentals required to finish the work, complete and accepted by the Engineer.

824.05.2 Structural Steel; Furnish and Fabricate. The accepted quantity of "Structural Steel; Furnish and Fabricate" will be paid for at the contract unit price per pound as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials and equipment, including fabricating, delivering, and all other incidentals required to finish the work, complete and accepted by the Engineer.

824.05.3 Structural Steel; Erect. The accepted quantity of "Structural Steel; Erect" will be paid for at the contract unit price per pound as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials and equipment, including

erection and all other incidentals required to finish the work, complete and accepted by the Engineer.

824.05.4 Surface Preparation for Weathering Steel. No separate payment will be made for this work. Rather, payment will be included with the payment, and at the contract unit price per pound as listed in the Proposal, for "Structural Steel; Weathering."

824.05.5 Shear Connectors. The accepted quantity of “Welded Stud Shear Connectors” will be paid for at the contract unit price as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, and equipment, and all other incidentals required to finish the work, complete, in place and accepted by the Engineer.

SECTION 825

PAINTING STRUCTURAL STEEL

825.01 DESCRIPTION. This work consists of painting or repainting structural steel, its components, or other steel materials. The work includes the elements of cleaning, surface preparation, the selection of an appropriate paint system, and the actual painting, all of which are subsequently defined herein. Painting work 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 Toxic Caveat. The Contractor is hereby notified that existing paint systems on the State's bridges may contain toxic substances such as lead or chromium, and that these substances are considered to be hazardous to personnel, the environment, and the public approximate to the project.

825.01.2 Personnel and Environmental Protection. The provision for protection of personnel, the environment, and the public covers the requirements for removal and containment of paint and/or corrosion products from any steel bridge or otherwise specified appurtenances during cleaning and painting operations. Requirements to assure that the public, the environment, the Contractor's and the State’s personnel are adequately protected and equipped from the harmful effects of lead, blast media, dust and fumes resulting from the Contractor's operations are set forth in **SECTION 826** of these Specifications and in the Special Provisions of the Contract Documents.

825.01.3 Certifications. All painting contractors, painting subcontractors, or other individuals engaged in work covered by this Specification, shall be duly certified under the Steel Structures Painting Council's Painting Contractor Certification Program. The Contractor/subcontractor shall be certified to SSPC-QPI - Standard Procedure for Evaluating Qualifications of Painting Contractors. The Contractor shall provide hard copy proof of such certification and the current status of said certification to the Engineer prior to the initiation of any work related to this item.

825.01.4 Definitions.

a. Cleaning. Cleaning under this Section shall be defined as adequate treatment of steel surfaces so that they can be properly prepared and subsequently painted.

b. Surface Preparation. Surface preparation under this Section shall be defined as the preparation of steel surfaces by scraping, grinding or abrasive blast methods so as to prepare the surfaces to properly receive the specified paint/coating system.

c. Paint Systems. A paint system consists of a specific combination of primer, intermediate and top coatings, each of which shall conform to a set of minimum acceptance criteria.

d. Painting. Painting under this Section shall be defined as the shop application in the case of new steel, and field application in the case of existing steel, of the prime coat of the specified paint/coating system. Also, the definition includes the field application of any intermediate and/or finish coats, whether new or existing steel, of the specified paint/coating system. Also included is the touch up and repair of the primer which may have been damaged during shipping, handling or erection.

825.02 MATERIALS. Paint materials shall conform to both the applicable provisions of **SECTION M.06; PAINT**, of these Specifications; to the Special Provisions included in the Contract Documents; and any manufacturer's recommendations contained herein. In case of conflict, manufacturer's recommendations shall govern. All materials shall meet the requirements for the system specified.

825.02.1 Paint Manufacturers. The materials for all coatings shall be furnished from the same paint producer and/or manufacturer to insure compatibility of components and coats.

825.02.2 Containers. All paint components shall be supplied in new, strong, air-tight containers. The containers shall be clearly marked with the manufacturer's name and address, quantity in each container, date of manufacture, lot or batch number, color, where appropriate, and other such pertinent information that will permit ready identification of the paint or its component materials.

825.02.3 Engineer's Access. The Engineer shall have free access afforded him/her for sampling of the components of the paint system and for the weighing of component materials going into the paint mixture prior to application of the paint. Samples of paint components may be subject to chemical analysis and, if found to be of unsatisfactory quality, shall be cause for rejection of the materials they represent.

Samples of paint components for acceptance shall be furnished from the paint manufacturer or supplier for laboratory testing, and to establish quality standards for comparison evaluation of subsequent on-site field samples.

825.02.4 Literature. Product data sheets (PDS) shall be supplied in accordance with **Subsection M.06.01.1** of these Specifications.

825.02.5 Color. The top coat shall be green (semi-gloss) to match Federal Standard 595 Color 24272, unless specifically noted otherwise on the Plans or elsewhere in the Special Provisions. Primers and intermediate coats are not required to have specific colors provided they contrast with each other and the top coat.

825.02.6 EPA Compliance. All materials utilized under this Specification shall be in compliance with the latest Volatile Organic Compound (VOC) emission requirements of the Environmental Protection Agency's Clean Air Act of 1977 or any revision thereto.

825.02.7 Paint Systems. Approved paint systems are set forth in **Special Provision Code 825.1000**. The Contractor may select a paint system for the work of this Contract from those contained in Code 825.1000 provided that each component of such system conforms to the minimum criteria stated therein.

825.03 CONSTRUCTION METHODS.

825.03.1 New Steel Structures. 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 the Special Provisions found in the Contract Documents.

a. Cleaning. Where oil and/or grease are present they shall be removed by solvent cleaning methods as described in the Steel Structures Painting Council Surface Preparation Specification No. 1; Solvent Cleaning (SSPC-SP1). This cleaning shall be performed prior to blast cleaning. If contamination remains after blast cleaning, the surfaces shall be recleaned with the SSPC-SP1 procedures.

b. Surface Preparation. Surface preparation shall be in accordance with the Steel Structures Painting Council Specifications and any additional requirements contained in the Special Provisions found in the Contract Documents.

All steel shall be blast cleaned to a near white condition using the cleaning methods described in the Steel Structures Painting Council Surface Preparation Specification No. 10; Near White Blast Cleaning (SSPC-SP10). The surface area of the steel to be blast cleaned shall be no greater than the surface area of steel that can be prime coated in the same day. The maximum time lapse between surface preparation and application of the prime coat shall not be greater than 8 hours. Should any "rust back" occur prior to the application of the prime coat, the surfaces shall be recleaned to the near white condition. The blast cleaning shall leave a 1.5 to 2.5 mil deep anchor profile in a dense uniform pattern of depressions and ridges.

Flame cut edges shall be ground before or after blast cleaning to assist in attaining the required anchor profile. All fins, tears, slivers and burred or sharp edges present before or after blast cleaning shall be removed by grinding or reblasting to attain the required anchor profile. All reamed or drilled holes in the steel shall have their edges cleaned and softened by grinding prior to blast cleaning.

The near white blast condition may be determined and/or verified by the use of a NACE No. 2 visual standard T.M.-01-75 when shot blast is used or SSPC pictorial standard guide Vis-1 if sand or grit is used. The surface profile depth shall be measured and/or verified by the use of an Elcometer surface profile gauge, or equal, or Testex Replica Tape.

Compressed air supply lines shall be equipped with oil traps and moisture separators. The traps and separators shall be cleaned and/or changed on a regular basis.

All abrasive and deleterious material residues shall be removed from steel surfaces with a commercial grade vacuum cleaner equipped with a brush type cleaning tool or by double blowing with clean compressed air. Air cleaning shall be followed up by vacuum cleaning of the top surfaces of all flanges, stiffeners, splice plates, hangers, etc. The steel shall then be kept dust free until the coating is applied.

Care shall be taken to protect freshly coated surfaces from subsequent blast cleaning operations. Previously primed surfaces damaged by subsequent blasting operations shall be returned to the near white condition by reblasting or wire brush cleaning. The surfaces shall then be vacuumed and reprimed.

The Contractor/fabricator shall provide access to any location where cleaning and painting may be in progress for servicemen, manufacturer's representatives, Department representatives or other duly authorized persons.

The Engineer's approval of the preparation of all surfaces to be painted is required before any paint is applied.

c. Painting.

1. Mixing. The coatings shall be mixed in their original containers. All paints shall be mixed with a high shear mixer to a smooth lump free consistency. Paddle mixers or paint shakers **shall not** be used. The mixing shall continue until all of the metallic powders or pigments are in suspension taking care that all solids that may have settled to the bottom of the container are thoroughly dispersed. All paints shall be strained through a 30-60 mesh screen to remove large particles. Paint containers for spray applications shall be equipped with a mechanical agitator so the mixture is in motion throughout the application period.

In general, coatings are supplied for use without thinning. Thinning will only be allowed for application of mist coats or for special circumstances. Any thinning that is deemed necessary shall be done in accordance with the manufacturer's recommendations and only with prior approval of the Engineer.

2. Conditions for Painting. Paint shall be applied on clean and dry surfaces only. Paint for the prime, intermediate and top coats shall not be applied when the temperature of the air, paint, or steel is below 40°F, or when the temperature is expected to fall below 40°F before the paint is cured. The paint for all coatings shall not be applied when the wind velocity is in excess of 20 mph, when the air is misty, or when, in the opinion of the Engineer, conditions are unsatisfactory for the work. Paint shall not be applied onto damp or frost covered surfaces or when the metal is hot enough to cause the paint to blister, become porous, or cause the vehicle to separate from the pigment. Paint shall not be applied when the steel surface temperature is lower than 5°F above the dew point. The dew point shall be determined by the use of a psychrometer (wet bulb thermometer) and appropriate tables. The coating shall not be applied when the relative humidity is greater than 85 percent nor when a combination of temperature and humidity conditions are such that moisture condenses on the surfaces to be coated. Daily logs of air and surface temperatures, dew point, and relative humidity in the shop, paint booth, external painting area, or field shall be maintained.

Before application of the primer touch up, intermediate or finish coat in the field, all zinc salts, oil, dust, dirt and other contaminants shall be removed from the steel or previously painted

surfaces to be painted. Primed surfaces shall be cleaned by a high pressure water washing (800 psi min.).

3. Paint Application. The coating system shall be capable of application by brush, roller, or spray (airless or conventional) methods. The method of application of each particular coat shall be the method most highly recommended by the coating manufacturer. The prime coat shall be applied immediately after inspection and acceptance of the surface. The primer shall be applied the same day the metal is cleaned (within 8 hours). If the surfaces remain unpainted overnight they shall be reblasted again prior to priming. Succeeding coats shall not be applied until each coat is approved by the Engineer. The minimum time between coats shall be in accordance with the manufacturer's recommendations. Depending on site conditions, additional time may be needed between coats to assure proper curing. It is the applicator's responsibility to determine if the coating has cured sufficiently for proper application of succeeding coats. Should the maximum time interval between coats be exceeded, surface preparation requirements shall be in accordance with manufacturer's recommendations.

Prior to application of the full prime coat, a prime coating (striping) shall be applied to all edges of plates, shapes, corners, crevices, welds, rivet heads and exposed parts of bolts. The full prime coat shall not be applied until the striping has set to the touch.

The coating of paint shall be smoothly and uniformly spread so that every part of the surface will be covered with at least the minimum specified thickness and so that no excess paint will collect at any point. A dense and uniform appearance is required after each coating has cured.

If the paint coating is too thin or if portions of the surface are not completely coated, such portions of the work shall be repainted. If the application of the coating at the required thickness in one coat produces runs, bubbles, or sags, the coating shall be applied in multiple passes of the spray gun. Where excessive coating thickness produces surface defects such as "mud cracking," such coating shall be removed back to soundly bonded coating and the area recoated to the required thickness. In areas of deficient primer thickness, the areas shall be thoroughly cleaned with power washing equipment, as necessary to remove all dirt. The areas shall then be wire brushed, vacuumed and recoated.

All dry spray shall be removed, by sanding if necessary, prior to the application of the succeeding coat.

Surfaces of steel which will be in contact or embedded in concrete and/or contact surfaces at field bolted connections shall be given a prime coat of paint only. These surfaces shall be masked during subsequent coating operations when applicable. Surfaces within two inches of field welds (except for stud shear connectors) shall not be painted, but receive a light coat of rust prohibitive coating and be masked during coating operations.

All bolted shop connections shall be removed prior to the blasting and coating of girders and beams. The parts shall be blasted and coated separately and then reassembled.

All bolts, nuts and washers used in final field splices and connections shall be field blasted, once the splice is complete, to SSPC-SP6 condition and primed in the same manner as all other structural steel components.

The coatings shall be applied using brushes, rollers, spray equipment or any combination of equipment that will attain satisfactory results and the film thickness specified.

4. Spray Painting. Spray nozzles and pressures shall be in accordance with manufacturer's recommendations.

When painting operations are interrupted, paint remaining in the hose shall be expelled from the hose. Spray equipment which is used for application of paints shall be thoroughly cleaned at the end of each workday.

Compressed air lines shall be provided with oil traps and moisture separators. The traps and separators shall be changed on a regular basis. Compressed air shall be in accordance with the blotter test as described in ASTM D4285.

5. Brush Painting. Brushes shall preferably be round or oval in shape, but if flat brushes are used they shall not exceed 4.5 inches in width. All brushes shall have sufficient body and length of bristle to spread the paint in a uniform coat. The paint shall be manipulated under the brush to produce a uniform, even coat in contact with the metal or with previously applied paint, and shall be worked into all corners and crevices. In general, the primary movement of the brush shall describe small circles to fill the irregularities in the surfaces, after which the coating shall be brushed out and smoothed by a series of parallel strokes until the paint film has an even thickness.

6. Roller Painting. Rollers, when used, shall be of the type that do not leave a stippled texture in the paint film. Rollers may be used only on flat, even surfaces. The rollers shall be manipulated in a manner to produce a paint film of even thickness with no skips, runs, sags, or thin areas. The roller operation should be followed closely by a bristle brush to level off any air bubbles.

7. Film Thickness. The coatings shall be applied so as to attain the film thicknesses specified by the manufacturer. Surfaces to be coated with primer include the faying (contact) surfaces of bolted field splices. The dry film thickness of the primer coat on the faying surfaces of main members and splice plates and on the top of top flanges, where stud shear connectors are to be welded, shall be 1.0 to 1.5 mils, maximum. The dry film thickness of all other areas of steel to be primed shall be in accordance with the manufacturer's recommendations.

The dry film thickness of the prime coat to bolts, nuts and washers shall be between 2.0 and 4.0 mils, maximum.

The dry film thickness of the intermediate and top coats shall be strictly in accordance with the recommendations of the manufacturer. For spray applications, the manufacturer's recommendations for build up of the coating shall be followed implicitly.

The dry film thickness for each coat will be determined by the use of a magnetic dry film thickness gauge. The gauge shall be calibrated and used in accordance with SSPC-PA2. Measurement of the dry film thickness of the prime coat shall take into account the surface profile of the steel surfaces as measured in accordance with ASTM D4417, Method C. Correction of the dry film thickness shall be accomplished by subtracting the dry film thickness to the imaginary plane of profile from the surface profile measurement.

A Tooke film thickness gauge shall be used in accordance with ASTM D4138 to verify the coating thickness when requested by the Engineer. If the Tooke gauge shows that the prime coat is not within the specified thickness range, the coat will be rejected and appropriate corrective measures shall be taken to assure an adequate coating thickness.

In addition to any equipment recommended by the coating manufacturer, the Contractor shall provide, for the exclusive use of the Engineer, the following supplemental equipment to permit the inspection of the coating system. The equipment must be in good and acceptable working condition and be properly calibrated as necessary. The equipment shall remain the property of the Contractor after the work is accepted.

Equipment:

NACE Visual Standards

SSPC Publications Vol. 1 and 2, and Visual Guide

Wet and Dry film thickness gauges -Tooke and magnetic gauge

Surface temperature thermometer

Psychrometer (battery operated) - for dew point

Testex adhesion tape or Elcometer adhesion tester

Elcometer surface profile gauge

NBS calibration standards and plastic shims

Filter masks or respirators (as recommended by the coating manufacturer)

Paint inspection mirror

Miscellaneous equipment as necessary.

8. Stenciling. The following information will be stenciled on the inside web of both fascia beams at both ends of the bridge:

The structure number - for example: (Br. #0000)
The month and year of completion
Paint system identification - for example: (Zinc/Epoxy/Urethane).

9. Sampling. Sampling of paint shall be in accordance with the requirements specified in the Department of Transportation Master Schedule for Sampling, Testing and Certification of Materials, or as directed by the Engineer.

The markings shall provide uniform 2-inch high C series letters and/or numerals with the paint being the same as the finish coat except that the color shall contrast i.e., light on dark or dark on light. The markings shall be located not less than 4 inches above the bottom flange and not more than three feet from the centers of bearing.

d. Unsatisfactory Performance. The paint performance shall be considered unsatisfactory if rusting occurs; the paint lifts, blisters, wrinkles, has excessive runs or sags, or shows evidence of application under unfavorable conditions; the workmanship is poor; impure or unauthorized paint has been used; or any other obvious reasons as noted by the Engineer. The unsatisfactory paint shall be removed, the metal recleaned and repainted, as specified above.

e. Handling, Storage and Erection. The paint shall be allowed to cure before loading and shipping of the steel. Extreme care shall be exercised in handling the steel in the shop, during shipping, erection, storage, and subsequent construction operations. The steel shall be insulated from binding chains by softening devices approved by the Engineer. Hooks and slings used to hoist steel shall be padded. Diaphragms and similar pieces shall be separated during shipping so as to prevent damage to the coatings. The steel shall be stored at the job site in such a manner that it does not rest on dirt; that water does not accumulate on pieces; and that the members do not fall or rest on each other.

Temporary supports or attachments for scaffolding or forms shall not damage the coating system. In particular, sufficient support pads shall be utilized for bracing on fascias.

Unpainted surfaces and field welded areas shall be cleaned, when the work is completed, in accordance with the above requirements and the complete coating system applied expeditiously.

Damaged and contaminated coatings shall be repaired as directed by the Engineer and the steel recleaned and recoated as specified above.

Scaffolding or other satisfactory means of access shall be erected by the Contractor for the Engineer for the purpose of inspecting the completed work. Rubber rollers or other protective devices shall be utilized to prevent damage to the finished coatings.

f. Technical Supervision. The resource of the paint manufacturer's representative will be required for shop and field applications. This representative shall be present to give the Contractor such aid and instructions in the application of the paint system as is required to obtain a satisfactory result that meets the approval of all parties. As a minimum the services of this representative will be required at the start up of all shop and field operations. In addition, the 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.

825.03.2 Existing Steel. Work under this paragraph shall include all steel not included under **Subsection 825.03.1; New Steel Structures.** In particular, this work includes new steel that is utilized in bridge rehabilitation, existing steel that is repaired, repainting of existing steel, maintenance painting, and any other miscellaneous painting not covered as noted above.

a. Cleaning, Surface Preparation, and Painting. Except as noted in these Specifications, cleaning, surface preparation and painting shall be performed in accordance with the Special Provisions included with the Contract Documents.

1. Cleaning. Cleaning is performed to prepare the steel surfaces for the surface preparation work and the subsequent painting of the steel surfaces. Prior to any surface preparation being performed, the Contractor shall, at a minimum, clean the tops of girder bottom

flanges by scraping them with a garden hoe or other appropriate device to remove all accumulated dirt, dung, and debris. Other required cleaning shall be performed in accordance with the Special Provisions.

2. Surface Preparation. Surface preparation, as required by the Special Provisions, shall be performed in accordance with the Steel Structures Painting Council Standard Specifications for Surface Preparation. The level of surface preparation shall be as noted in the Special Provisions.

Blast cleaning, where specified, shall be performed by the Abrasive Blast Cleaning Method only and shall be performed with shot, grit or dry sand. All blast cleaning materials used shall pass through a standard 16-mesh screen. Metallic abrasives shall have a Rockwell Hardness coefficient ranging from 30 Rc to 60 Rc and the work mix shall be capable of producing a 2.0 to 4.0 mil surface profile. Non-metallic abrasives shall have a Mohr Hardness scale number ranging from 4.0 to 8.0, shall be angular shaped and shall preferably provide a low-medium degree of dusting. Non-metallic abrasives shall also be capable of producing a 2.0 to 4.0 mil surface profile.

Surface preparation operations shall be performed in such a manner that no damage is done to partially or entirely completed portions of the work.

Following the cleaning operation, it is required that all blast abrasives and cleaning and paint residue shall be removed with a commercial vacuum cleaner or by double-blowing with clean, compressed air followed by vacuuming of horizontal surfaces.

All areas in which bare metal is exposed shall be covered with the prime coat within 24 hours after cleaning. If any rust forms after the final cleaning is approved, the surfaces shall be recleaned to the condition previously approved by whichever of the above methods is appropriate.

No paint shall be applied to any surface until the Engineer or his representative has approved the cleanliness of the surfaces to be painted.

3. Painting. Unless otherwise noted in the Special Provisions included in the Contract Documents, the painting of existing steel shall be performed in accordance with the applicable requirements of **Para. c** of **Subsection 825.03.1** of these Specifications.

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 shall be considered as incidental to the painting work and, therefore, shall 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 other 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 other 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 shall not be paid for separately but shall 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 other incidentals required to finish the work, complete and accepted by the Engineer.

SECTION 826

PERSONNEL AND ENVIRONMENTAL PROTECTION

826.01 DESCRIPTION. This work consists of providing protection for both persons and the environment during the blast cleaning of existing structural steel prior to the repainting of said steel, all in accordance with these Specifications.

Specifically this provision covers the requirements for removal and containment of paint and/or corrosion products from any steel bridge or specified appurtenances during blast cleaning operations. Also covered by this Specification are the requirements to assure that both Contractor and Department employees are adequately equipped and protected from the harmful effects of lead, blast media dust and fumes from the blasting operations.

This provision is associated with, and applies to, **SECTION 825; PAINTING STRUCTURAL STEEL**, of these Specifications.

826.01.1 Toxic Caveat. The Contractor is hereby notified that existing paint systems on the State's bridges may contain toxic substances such as lead or chromium, and that these substances may be considered hazardous wastes when removed.

826.01.2 Legal Responsibilities. The Contractor is directed to **SECTION 107; LEGAL RELATIONS AND RESPONSIBILITY TO THE PUBLIC** of these Specifications. This Section requires the Contractor to assume responsible charge of the worksite and to conform with all Federal, State, and Municipal laws relating to the work.

By definition, the Department is the "generator" of the waste and is, therefore, directly responsible for complying with the applicable laws and regulations. The Contractor shall be liable to the Department for any fines, penalties, or remediation costs incurred by the Department as a result of the Contractor's failure to comply with either the applicable laws and regulations or these Specifications.

826.02 MATERIALS. Not applicable.

826.03 CONSTRUCTION METHODS.

826.03.1 General. The Contractor shall be responsible for providing adequate protection for pedestrian, vehicular, and other traffic upon and underneath structures in accordance with both **SECTION 107** of these Specifications and any additional provisions of this Section.

Provisions for protection shall provide for a barrier that protects vehicles, vessels or pedestrians from direct or indirect exposure to the blasting operations, and prevents abrasive materials or debris from falling onto traveled portions of the roadway, into waterways or any other place where a traffic hazard may be created. Whenever the intended purpose of the protective devices is not being accomplished, work shall be suspended until corrections are made.

Any and all portions of the structure and its appurtenances that could be damaged by the blast cleaning operations shall be protected by covering or shielding.

826.03.2 Containment. Total containment of all debris or spent materials is required during the blast cleaning operations or subsequent air blowing or vacuuming of the work area.

a. Containment, Collection, Storage, and Disposal of debris and spent materials shall be performed in accordance with the Special Provisions contained in the Contract Documents. Additionally, all containment, collection, storage and disposal of debris and spent materials resulting from the cleaning operations shall comply with the latest rules, regulations, requirements, standards and/or procedures of the following agencies which shall include, but not necessarily be limited to, the following:

1. The Environmental Protection Agency, 40 CFR Part 745 "Lead; Requirements for Lead Based Paint Activities."

2. Rhode Island Department of Environmental Management; Division of Air and Hazardous Materials:

(a) Air Pollution Control Regulation No. 5, "Fugitive Dust."

(b) "Air Pollution Control Regulation No. 24, Removal of Lead Based Paint From Exterior Surfaces."

(c) "Rules and Regulations for Hazardous Waste Generation, Transportation, Treatment, Storage, and Disposal."

(d) "Rules and Regulations for Solid Waste Management Facilities."

826.03.2 Personnel Protection.

a. Painting and Cleaning Operations. During Painting and Cleaning Operations, the Contractor must assure that the workers engaged in the removal of lead based paints and blast cleaning operations, both those of the Contractor and the State, are adequately trained, protected, equipped, and monitored against the harmful effects of lead and blast media during all phases of the painting operations. Personnel protection and all of its related activities and requirements shall be performed in accordance with the Special Provisions contained in the Contract Documents. Additionally, all monitoring respiratory protection, protective clothing, housekeeping and hygiene, medical surveillance, medical protection, training, signs and record keeping shall comply with the latest rules, regulations, requirements, standards and/or procedures of the following agencies which shall include, but not necessarily be limited to, the following:

1. The Occupational Safety and Health Administration, 29 CFR Part 1926 as well as, and more specifically, Part 1926 as well as, and more specifically, Part 1926 .62, "OSHA Standard for Lead in the Construction Industry" with appendices; A - "Substance Data Sheet for Occupational Exposure to Lead," B-"Employee Standard Summary," C-"Medical Surveillance Guidelines," and D-"Qualitative and Quantitative Fit Test Protocols."

2. Rhode Island Department of Health, Environmental Lead Program, "Rules and Regulations for Lead Poisoning Prevention as applicable.

The above documents should be available as applicable through the local offices of the U.S. Department of Labor, Occupational Safety and Health Administration. The location of these offices is indicated in **Special Provision Code 826.1000** of the Contract.

The Contractor shall be responsible for providing the necessary testing equipment, protective clothing and facilities as required by the above documents.

826.04 METHOD OF MEASUREMENT. "Containment, Collection, Storage and Disposal of Debris and Spent Materials" will not be measured separately for payment. "Personnel Protection During Painting and Cleaning Operations" will not be measured separately for payment.

826.05 BASIS OF PAYMENT. "Containment, Collection, Storage and Disposal of Debris and Spent Materials" will be paid for at the contract lump sum price as listed in the Proposal. The price so stated shall constitute full and complete compensation for all materials, labor, equipment, collection and containment equipment, storage requirements, engineering, sampling, testing, disposal fees and all other incidentals required to finish the work, complete and accepted by the Engineer.

"Personnel Protection During Painting and Cleaning Operations" will be paid for at the contract lump sum price listed in the Proposal. The price so stated shall constitute full and complete compensation for all materials, labor, equipment, monitoring devices, changing and shower facilities, professional hygienist, medical facilities and all other incidentals required to finish the work complete and accepted by the Engineer.

SECTION 827

THERMAL SPRAYED ZINC COATING FOR NEW STRUCTURAL STEEL

827.01 DESCRIPTION. This work consists of thoroughly cleaning, preparing surfaces, and applying an application of thermal sprayed zinc coating to the surfaces of new structural steel and its components at the locations indicated on the Plans or as directed be the Engineer, all in accordance with these Specifications.

827.02 MATERIALS. Materials shall conform to the applicable requirements of **Subsection M.05.07; Metalizing**, of these Specifications.

827.03 CONSTRUCTION METHODS.

827.03.1 Surface Preparation.

a. Blast Equipment. Blast equipment shall be conventional air type. Under no circumstances is any type of water or vapor blast to be utilized.

The air supplied for blasting will have sufficient pressure at the nozzle to achieve the desired profile, and shall be clean and free of oil and moisture. Surfaces prepared for metal spraying shall also be kept free from oil and moisture until zinc coating has been applied.

b. Blast Cleaning. The blasting operation shall be performed in a block or sectional method and must be continued until all foreign matter and scale on the original surface has been removed and until the cleaned metal surface is bright and completely abraded by the abrasive.

All steel surfaces shall be cleaned to a white metal condition using the methods described in the Steel Structures Painting Council Surface Preparation Specification No. 5; White Metal Blast Cleaning (SSPC-SP5). The steel surface temperature must be a minimum of 2.8^{O}C (5°F) above the dew point. Abrasive used shall be as specified above. The blast cleaning shall leave a 2.0 to 4.0 mil deep profile in a dense uniform pattern of depressions and ridges. Surface profile

depth shall be measured and/or verified by the use of an Elcometer surface profile gauge, or equal, or Testex Replica Tape.

All blasting debris shall be contained, collected, stored, and disposed of in accordance with the latest environmental regulations in effect.

Blow down, brush and/or vacuum the surface of the steel to remove all visible abrasive and dust from the surfaces to be thermal spayed. Erection marks, for the field identification of members, and weight marks shall be transferred or preserved. Any grease pencil marking shall be removed by solvent wiping.

The Engineer's approval of the preparation of all surfaces is required before any thermal sprayed zinc is applied.

827.03.2 Thermal Spraying Zinc.

a. Thermal Spray Equipment. Thermal spray guns manufactured by an established domestic company of the gas or arc type are acceptable and recommended. The equipment shall be used in accordance with the manufacturer's recommendations.

b. Thermal Spraying. All surfaces shall have been prepared in accordance with the requirements set forth above in **Subsection 827.03.1.**

No surface shall be sprayed which shows any sign of rust, scale, moisture, or foreign matter. At least one single layer of the coating must be applied within a maximum of 4 hours of the blasting. The sprayed metal shall overlap on each pass, in a cross hatch block pattern not to exceed 2 feet square to insure uniform coverage. The specified thickness of the coating shall be applied in multiple layers and in no case less than two passes of the spraying shall be made over every part of the surface.

Coating operations shall be performed in a neat and workmanlike manner, producing a uniform, even coating which is bonded firmly with the steel. The coating shall be free from uncoated spots, lumps, or blisters, and shall have a uniform sprayed fine texture finish.

The dry coating thickness shall be 8.0 mils (±1 mil). The coating thickness shall be measured using the methods described in the Steel Structures Painting Council Paint Application Specification No. 2 - Measurement of Dry Paint Thickness with Magnetic Gauges (SSPC - PA2).

All steel coated with impure, unsatisfactory, or unapproved coating material, or coated in an unworkmanlike manner, shall be removed and recoated or otherwise corrected as directed by the Engineer. Areas not meeting the coating thickness requirements above shall be resprayed to the specified thickness after appropriate surface preparation.

c. Field Repair. All field repair shall be made in strict accordance with the material supplier's recommendations, these Specifications, and shall be approved by the Engineer.

827.03.3 Subsequent Coatings. Any top coating over the zinc required by the Contract shall be compatible with the zinc and be applied in accordance with the appropriate Specifications.

827.03.4 Approval Requirements.

a. Samples. The Contractor must submit at least 30 days prior to zinc metalizing application a steel plate approximately 12" x 12" to which zinc coating has been deposited to the specified thickness, (as checked with a fixed probe gauge), for acceptance by the Engineer as to grain size and texture of the sprayed metal. Such plate will be used to determine the acceptance of the finished job. These plates shall be prepared by the same profiling process and have the same surface profile as the steel surface to be thermally sprayed. In the event the Contractor's production coating is inferior to the sample, he shall be required to correct the coating by an acceptable repair method and do a job comparable to the specimen submitted.

b. Qualification/Certifications. The Contractor is responsible for providing certification for each journeyman applicator to the inspector prior to production assignment.

The inspector shall review the certification provided by the Contractor. If in the course of the work a certified journeyman applicator's work is not considered satisfactory, the Contractor may be requested to recertify or replace that particular journeyman applicator. If recertification is required, it shall be accomplished by the following procedure under the direction of the inspector.

Recertification shall be conducted in a suitable location removed from the area of ongoing work operations.

The qualifying test for recertification shall consist of the journeyman applying the coating system to the test panel in accordance with the requirement of the application procedure(s), and shall include at a minimum:

Installation of the thermal spray system in accordance with the manufacturer's recommendations.

Adjusting the system operating parameters in accordance with the manufacturer's recommendations.

Apply a steady and even application of sprayed metal to a right angle joint in order to avoid an excessive buildup in the fillet area.

Repair of defect made by means of a hammer and chisel in the test panel.

c. Quality Control (Process Control). In addition to the general process control requirements of the Contract, the following specific process control items shall be required.

Technical supervision will be required for shop and field applications. Daily logs of air and surface temperature, dew point and relative humidity shall be maintained. The surface profile of each beam will be measured using Testex (or equal) replica tape and retained. This shall be made available to the State inspector on request.

d. Safety and Health. Employees required to enter confined spaces where the work is being conducted shall be instructed as to the nature of the hazards involved, the necessary precautions to be taken, and in the use of protective and emergency equipment required. All pertinent OSHA regulations shall apply.

827.04 METHOD OF MEASUREMENT. "Thermal Sprayed Zinc Coating" will be measured by the number of square feet of steel actually sprayed in accordance with the Plans and/or as directed by the Engineer.

827.05 BASIS OF PAYMENT. The accepted quantity of "Thermal Sprayed Zinc Coating" will be paid for at the contract unit price per square feet as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, equipment, tools, technical supervision, and all other incidentals required to finish the work, complete and accepted by the Engineer.

SECTION 828

BRIDGE BEARINGS

828.01 DESCRIPTION. This work consists of furnishing and installing bridge bearings. Bearing types specified in this provision include elastomeric pads, pot and disc bearings and sliding bearings. Other types of bridge bearings, if required, will be specified in the Special Provisions.

Included as components of bridge bearings are masonry, sole and shim plates, anchor bolts, elastomeric elements, TFE (teflon) sheets or surfacing, lubricants and adhesives. Bridge bearings shall be fabricated and installed in accordance with the details indicated on the Plans, or as directed by the Engineer, all in accordance with these Specifications.

828.01.1 Elastomeric Pad Bearings. Elastomeric bearings shall include unreinforced pads (consisting only of elastomer) and bearings reinforced with steel or fabric laminates.

828.01.2 Pot and Disc Bearings. Pot and disc bearings provide both rotation in all directions and sliding in those specific directions indicated on the Plans. Rotation is provided by an elastomeric element and sliding is provided by a sheet of polytetrafluoroethylene (TFE). Manufacturers of pot and disc bearings are included in the Department's Approved Materials List.

The pot and disc bearings detailed on the Plans are of a conceptual nature only. Minimum bearing capacities are indicated on the tables on the Plans. Bearings fabricated by manufacturers listed in the Department's Approved Materials List or other qualified manufacturers will be accepted.

The overall width and/or length of pot and disc bearings must fit within the limits of the concrete beam seats. The overall height of the bearings must be known before the precise beam seat elevation can be determined. Therefore, basic details of the bearings shall be submitted to the Engineer within sixty days after Contract award, all in accordance with the provisions of **Subsection 105.02; Plans and Shop Drawings,** of these Specifications.

828.01.3 Sliding Bearings. Sliding bearings consist of the following types.

a. Expansion Bearings. Type A bearings prevent transverse movement, and Type B bearings allow transverse movement.

b. Fixed Bearings. Type C bearings prevent transverse movement, and Type D bearings allow transverse movement.

828.02 MATERIALS.

828.02.1 Elastomeric Bearings.

a. Elastomer. The raw elastomer shall be virgin neoprene (polychloroprene). The elastomer compound shall be classified as being of low temperature grade 0, 2, 3, 4, or 5 as defined by the testing requirements in Table 18.2.3.1A in Section 18 of the AASHTO Standard Specifications for Highway Bridges (Fifteenth Edition).

b. Steel Laminates. Steel laminates used for reinforcement shall be fabricated from rolled mild steel conforming to the requirements of ASTM A36 or A570 unless otherwise specified by the Engineer. The steel laminates shall have a minimum nominal thickness of 16 gauges. Holes in plates for manufacturing purposes will not be permitted unless they have been accounted for in design, and indicated as such on the Plans.

c. Fabric Reinforcement. Fabric reinforcement shall be woven from 100 percent glass fibers of "E" type yarn with continuous fibers. The minimum thread count in either direction shall be 25 threads per inch. The fabric shall have either a crowfoot or an 8 Hardness Satin weave. Each ply of fabric shall have a minimum breaking strength of 800 lb/in. of width in each thread direction. Holes in the fabric will not be permitted.

d. Bond. The vulcanized bond between fabric and reinforcement shall have a minimum peel strength of 30 lb/in. Steel laminated bearings shall develop a minimum peel strength of 40 lb/in. Peel strength tests shall be performed by ASTM D429 Method B.

828.02.2 Pot and Disc Bearings. All materials used in the manufacture of pot and disc bearings shall be new and unused. No reclaimed materials shall be incorporated in the finished bearings. All pot and disc bearings required for the Contract shall be fabricated by a single manufacturer.

Materials, including the elastomeric rotational element, sealant, sealing rings, steel, stainless steel, and TFE sheet shall conform to the requirements of Subsection 18.3.3 of the AASHTO Standard Specifications for Highway Bridges (Fifteenth Edition).

828.02.3 Sliding Bearings.

a. Carbon Steel. Sole, pivot and masonry plates shall conform to the requirements of AASHTO M270, Grade 36.

b. Stainless Steel. Stainless steel shall conform to the requirements of ASTM A240, Type 304 or ASTM A167, Type 304.

c. Polytetrafluoroethylene (TFE). TFE resin shall be virgin material (not reprocessed) conforming to the requirements of ASTM D1457. Specific gravity shall be between 2.13 and 2.19. The melting point shall be $623^{O}F \pm 2^{O}$.

d. Bedding of Masonry Plates.

1. Preformed Fabric Pads used as bedding shall be composed of multiple layers of 8-ounce cotton duck impregnated and bonded with high quality natural rubber or of equivalent and equally suitable materials compressed into resilient pads of uniform thickness. The number of plies shall be such as to produce the specified thickness, after compression and vulcanizing. The finished pads shall withstand compression loads perpendicular to the plane of the laminations of not less than 10,000 pounds per square inch without detrimental reduction in thickness or extrusion.

2. Sheet Lead used as bedding shall be common desilverized lead conforming to ASTM B29. The sheets shall be of uniform thickness and shall be free from cracks, seams, slivers, scale, and other defects. Unless otherwise specified, lead sheets shall be 1/8-inch in thickness with a permissible tolerance of ±0.03-inch.

e. Anchor bolts, including nuts and washers, shall be galvanized and shall conform to the applicable requirements of **Subsection M.05.04.4** of these Specifications.

828.03 CONSTRUCTION METHODS.

828.03.1 Elastomeric Bearings.

a. Fabrication. Bearings with steel laminates shall be cast as a unit in a mold and shall be bonded and vulcanized under heat and pressure. The mold finish shall conform to standard shop practice. The internal steel laminates shall be sandblasted and cleaned of all surface coatings, rust, mill scale, and dirt before bonding, and shall be free of sharp edges and burrs. External load plates (sole plates) shall be protected from rusting by the manufacturer, and preferably shall be hot bonded to the bearing during vulcanization. Bearings that are designed to act as a single unit with a given shape factor must be manufactured as a single unit.

Plain pads may be molded, extruded, or vulcanized in large sheets and cut to size. Cutting shall not heat the material, and shall produce a smooth finish.

b. Fabrication Tolerances. Plain pads and laminated bearings shall be fabricated to the dimensions indicated on the Plans within the tolerances set forth in the table of Subsection 18.2.5 of the AASHTO Standard Specifications for Highway Bridges (Fifteenth Edition).

c. Compression Tests. Bearing pads will be selected at random at the project site for testing. Two samples of complete pads will be tested. Testing shall be performed by the Engineer and conducted in accordance with Subsection 18.2.7.6; Short-Duration Compression Tests on Bearings, of the AASHTO Standard Specifications for Highway Bridges (Fifteenth Edition).

The Contractor shall furnish additional complete pads to replace those taken for testing. Sample pads used for testing shall be provided by the Contractor at no additional cost to the State. Pads will be available for testing at least three weeks in advance of installation.

d. Installation. Bearing pads are to be cemented to the beam seats on abutments and pier caps with a two-part epoxy glue which is compatible with the materials of the bearing pad and the concrete and which is recommended by the manufacturer for the intended use. The bearing

seat is to be finished straight and true with the plane of contact as detailed on the Plans. The concrete surface of the beam seat is to be thoroughly cleaned of all laitance and construction residue prior to attaching the pads. Pads shall be cemented to the beam seats prior to the application of concrete protective coating to bent caps. The Contractor shall follow the manufacturer's recommendations for treatment of neoprene surfaces before applying adhesive. Pads are not to be cemented to the girders. The Contractor shall exercise care to insure that the pads are not deformed during the setting of the girders in their final position. If bearing pads are so-deformed during the setting operation, the girders shall be lifted, thereby allowing the pads to resume their proper configuration, and then carefully reset. When further adjustment of elastomeric type bearing pads is necessary to accommodate for variations in ambient temperature at the time of erection, the Contractor shall make those adjustments in accordance with the alignment scheme provided on the Plans. The method of adjusting the alignment shall be proposed by the Contractor and approved by the Engineer.

828.03.2 Pot and Disc Bearings.

a. Fabrication. The Contractor shall provide the Engineer with written notification thirty days prior to the start of bearing fabrication.

The finish of the mold used to produce the elastomeric rotational element for pot bearings and elastomeric disc for disc bearings shall conform to the practice in modern machine shops.

After fabrication, steel surfaces exposed to the atmosphere, except stainless steel surfaces, shall be shop painted or coated to protect against corrosion in accordance with the Plans or Specifications. Prior to coating, the exposed steel surfaces shall be cleaned in accordance with the recommendations of the coating's manufacturer. Metal surfaces to be field welded shall be given a coat of clear lacquer or other protective coating approved by the Engineer, if the time of exposure before welding takes place is to exceed three months. The lacquer coating shall be removed at the time of welding. The final painting or coating of these surfaces shall be done after the completion of welding.

Stainless steel sheet shall be attached to its steel substrate with an approved epoxy to insure complete contact, and then sealed with a continuous seal weld.

For pot bearings, the steel piston and the steel pot shall each be machined from a solid piece of steel. The steel base pot of all bearings shall be either integrally machined, recessed into, or continuously welded to its bottom steel masonry plate. The outside diameter of the piston shall be no more than 0.030-inch less than the inside diameter of the pot at the interface level of the piston and elastomeric rotational element. The sides of the pistons shall be beveled to facilitate rotation.

All welding shall conform to, and all welders shall be qualified in accordance with the requirements of the ANSI/AASHTO/AWS D1.5 Bridge Welding Code.

Except as noted, all bearing surfaces of steel plates shall be finished or machined flat within 0.010-inch per foot. Out-of-flatness greater than 0.010-inch per foot on any plate shall be cause for rejection. The bottom surfaces of lower bearing plates (masonry plates) designed to rest on bearing pads shall not exceed an out-of-flatness value of 0.0625 inch per foot. Oxygen cut surfaces shall not exceed a surface roughness value of 1,000 micro-inches, as defined by ANSI B-46.1.

Every bearing shall have the Project Identification Number, Lot Number, and individual bearing number indelibly marked with ink on a side that will be visible after erection.

b. Testing and Acceptance. The manufacturer shall select, at random, sample bearings from completed lots of bearings for testing by the manufacturer. The manufacturer shall complete the required testing and determine compliance with this Specification before submitting the lots(s) for quality assurance inspection, testing, and acceptance consideration. The results of the manufacturer's tests shall be furnished to the Engineer.

c. Installation. The Contractor shall certify to the Engineer that a skilled representative of the bearing manufacturer will be available to the Contractor to provide advice and instruction during the installation of bearings.

The manufacturer's representative shall be present during the initial installation of the bearings. The representative shall remain on the job until, in the opinion of the Engineer, the bearing installation is proceeding smoothly and the workmen are familiar with the work required for each installation. The Contractor shall also arrange to have the representative present at such other times as the Engineer may request.

The bearing shall be placed at the predetermined locations at the time of structural steel erection. All temporary restraints shall be removed as directed by the bearing manufacturer. The expansion bearings shall be adjusted from the normal position to allow for the ambient temperature at the time of erection in accordance with the alignment scheme as indicated on the Plans. After all adjustments and at the approval of the Engineer, the bearing sole plate shall be welded to the bottom flange.

828.03.3 Sliding Bearings.

a. Fabrication. Fabrication of sliding bearings shall conform to the details indicated on the Plans. Fabrication shall be performed in a workmanlike manner in conformance with the practice in modern commercial shops. Burrs, rough or sharp edges and other flaws shall be removed.

Horizontally installed TFE sheet shall be bonded to and recessed into its steel substrate. TFE sheet shall have a minimum thickness of 1/8-inch and shall be recessed for at least one-half of its thickness into its steel substrate.

Stainless steel matting surfaces shall have a surface finish less than 20 micro-inches (rms) and shall be polished as necessary to meet the friction requirements indicated on the Plans.

b. Testing and Acceptance. The manufacturer shall furnish facilities for testing and perform testing and inspection of the completed bearings or representative samples of bearings with TFE surfaces in its plant or at an independent test facility. Inspectors, if appointed, shall be allowed free access to the necessary parts of the manufacturer's plant and test facility. When testing is performed by the manufacturer, copies of the test results shall be submitted to the Engineer.

c. Installation. Sliding bearings shall be installed in accordance with the alignment scheme as indicated on the Plans. The setting of sliding bearings shall take into account any variation from mean temperature of the supported span at the time of setting. Care shall be

exercised such that full and free movement of the superstructure at movable bearings is not restricted by improper settings or adjustment of the bearings.

828.04 METHOD OF MEASUREMENT. "Elastomeric Bearings," both plain and reinforced, "Pot Bearings," "Disc Bearings," and "Sliding Bearings" will be measured by the number of each type of bearing actually installed in accordance with the Plans and/or as directed by the Engineer.

828.05 BASIS OF PAYMENT. The accepted quantities of "Elastomeric Bearings," both plain and reinforced, "Pot Bearings," "Disc Bearings," and "Sliding Bearings" will be paid for at their respective contract unit prices per each such bearing as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, materials, and equipment, including testing, services of the manufacturer's representative, when required, bedding pads, anchor bolts, and all other incidentals required to finish the work, complete and accepted by the Engineer.

SECTION 829

BRIDGE SCUPPER PIPING

829.01 DESCRIPTION. This work consists of providing polyvinyl chloride scupper piping on bridges at the locations indicated on the Plans, or as directed by the Engineer, all in accordance with these Specifications.

829.02 MATERIALS.

829.02.1 Polyvinyl Chloride Scupper Piping.

a. Pipe shall conform to the requirements of ASTM D 1785; PVC 1120; Schedule 80. Solvent cement fittings shall conform to the requirements of ASTM D 2467; Schedule 80.

b. Hardware. Straps, angles, etc, shall conform to the requirements of **SECTION M.05; METALS**, and shall be galvanized in accordance with AASHTO M111.

c. Manufacturer's Certification. The Contractor shall furnish the manufacturer's certification that the materials provided meet specification requirements.

829.03 CONSTRUCTION METHODS.

829.03.1 Polyvinyl Chloride Scupper Piping.

a. Field Measurements. The Contractor shall make all appropriate field measurements and evaluate special conditions for installation prior to the preparation of shop drawings.

b. Shop Drawings. The Contractor shall submit shop drawings of the pipe assembly in accordance with **Subsection 105.02** of these Specifications.

c. Handling. Special care shall be taken during handling and storage to avoid damage to the pipe from impact, bending, compression or abrasion.

d. Preparation. Pipe shall be cut with saws or pipe cutters designed specifically for polyvinyl chloride material. The pipe and fittings shall be protected from serrated holding devices and abrasions. All burrs shall be removed and dust and dirt shall be wiped clean from jointing surface. Pipe ends shall be beveled in accordance with the manufacturer's recommendations.

e. Installation. The pipe shall be installed and supported, and joints made in strict accordance with the manufacturer's recommendations. Jointing surface must be softened and made semi-fluid and sufficient cement must be supplied to fill the gap between pipe and fittings. All excess cement must be removed.

829.04 METHOD OF MEASUREMENT. "Polyvinyl Chloride Scupper Piping" will be measured by the number of linear feet of each type of drainpipe actually installed in accordance with the Plans and/or as directed by the Engineer.

829.05 BASIS OF PAYMENT. The accepted quantities of "Polyvinyl Chloride Scupper Piping" will be paid for at their respective contract unit prices as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, materials and equipment, including straps, hardware, bolts and all other incidentals required to finish the work, complete and accepted by the Engineer.

SECTION 830

METAL BRIDGE RAILING

830.01 DESCRIPTION. This work consists of the provision of any one of several types of bridge rail at the locations indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications. The types of railing covered by this provision are: Aluminum One-Bar Ornamental Rail; Steel Four-Bar Rail; Baldwin Four-Bar Ornamental Rail; and Steel Two-Bar Rail (Crash Tested).

830.02 MATERIALS. Materials for bridge railing shall conform to both the applicable provisions of **SECTION M.05; METALS,** of these Specifications and the following additional requirements.

830.02.1 Posts.

a. Aluminum Posts shall be shaped of cast aluminum fabricated from material which conforms to ASTM alloys A444.0-T4, A356.0-T61, or A356.0-T6.

b. Steel Posts for Steel Four-Bar Rail and Baldwin Four-Bar Ornamental Rail shall be wide flange sections which conform to the requirements of AASHTO M 270, Grade 36.

c. Steel Posts for the Two-Bar Rail (Crash Tested) shall be wide flange sections which conform to the requirements of AASHTO M233, Grade 50.

830.02.2 Rails.

a. Aluminum Rails shall be aluminum pipe fabricated from material which conforms to ASTM alloys 6061-T6, 6063-T6, or 6351-75.

b. Steel Rails for Steel Four-Bar Rail and Baldwin Four-Bar Ornamental Rail shall be either standard or extra strong steel pipe which conforms to the requirements of ASTM A53, Grade B.

c. Steel Rails for Two-Bar Rail (Crash Tested) shall be hollow structural steel tubing which conforms to the requirements of ASTM A500, Grade B.

830.02.3 Plates.

a. Steel Plates shall conform to the requirements of AASHTO M270, Grade 36.

830.02.4 Anchor Bolts.

a. Anchor Bolts shall conform to the requirements of ASTM A307.

b. Threaded rods, nuts, and washers shall conform to the requirements of AASHTO M164.

c. Anchor Bolt Assemblies shall be galvanized after fabrication in accordance with the requirements of AASHTO M111.

830.02.5 Galvanizing and Painting.

a. When specified on the Plans or in the Special Provisions, steel railing assemblies shall be galvanized in accordance with the requirements of AASHTO M111.

b. Fasteners including bolts, nuts, cap screws, washers and lock washers shall be galvanized in accordance with AASHTO M232.

c. Galvanized Railings shall either remain unpainted or painted as set forth on the Plans or Special Provisions.

830.03 CONSTRUCTION METHODS. The railings shall be accurately positioned at locations shown on the Plans. Posts shall be installed vertical in the longitudinal plane of the bridge, except that if no part of the rail has a gradient greater than 1½ percent, the posts may be mounted normal to the slope. The bases shall in general be mounted level by the use of lead shims unless otherwise designated on the Plans.

Rails shall be installed in pieces of maximum practical lengths over several panels. Sequence of assembly to accomplish such continuity must be submitted with the shop drawings. The rail supports on posts shall be drafted or pitched to permit continuity of rails past the posts without cramping or crimping the rails.

If rails are to be shop cut, positioning of anchor bolts must be checked in the field prior to cutting to establish rail lengths. Adjacent anchor bolts shall be trimmed as necessary to present a visual uniformity of grips. The anchor bolts shall extend or be trimmed to a proper grip for the nut. All aluminum faces to be installed in contact with concrete or dissimilar metal surface shall be heavily coated with an approved aluminum impregnated caulking compound or zinc chromate paint. Alternatively, a synthetic rubber gasket may be placed between the two surfaces.

830.04 METHOD OF MEASUREMENT. "Aluminum One-Bar Ornamental Rail," "Steel Four-Bar Rail," "Baldwin Four-Bar Ornamental Rail," and "Steel Two-Bar Rail (Crash-Tested)" will be measured by the number of linear feet of each such type actually installed in accordance with the Plans and/or as directed by the Engineer.

830.05 BASIS OF PAYMENT. The accepted quantities of "Aluminum One-Bar Ornamental Rail," "Steel Four-Bar Rail," "Baldwin Four-Bar Ornamental Rail," and "Steel Two-Bar Rail (Crash-Tested)" will be paid for at their respective contract unit prices per linear foot as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, materials and equipment, including anchor assemblies and all other incidentals required to finish the work, complete and accepted by the Engineer.

SECTION 831

PEDESTRIAN CHAIN LINK FENCE - ALUMINUM

831.01 DESCRIPTION. This work consists of providing aluminum chain link fence at the locations indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

831.02 MATERIALS. Materials for pedestrian chain link fence shall conform to both the applicable provisions of **SECTION M.08; FENCE AND GUARDRAIL**, of these specifications and the following additional requirements.

831.02.1 Wire Fabric. Aluminum chain link fence wire fabric shall be No. 9 gauge (.148" diameter) wire fabric and shall have a uniform diamond mesh measuring approximately 2 inches between parallel sides. It shall be woven from aluminum alloy 6061 T89-94 (ASTM B211) wire having a minimum tensile strength of 50,000 psi. After the fabric has been woven, it shall be cleaned to remove all weaving compounds and foreign matter.

831.02.2 Posts. Aluminum posts shall be 2½-inch schedule 40 (2.875" OD) pipe weighing 2.004 pounds per foot. The posts shall be aluminum alloy 6061-T6 (ASTM B221).

831.02.3 Rails. Aluminum rails shall be 1¼-inch schedule 40 (1.660" OD) pipe weighing 0.786 pounds per foot. The posts shall be aluminum alloy 6061-T6 (ASTM B221).

831.02.4 Fittings and Appurtenances. All fittings (tension bars, rail splices, washers and post connection clamps) shall be aluminum alloy 6061-T6 (ASTM B221). The nuts shall be aluminum alloy 6061-T6 (ASTM B316). The bolts shall be aluminum alloy 2024-T4 (ASTM B316).

a. Wire Fabric Connections. Aluminum fabric shall be securely fastened to all terminal posts by 1 inch by 1/4-inch tension bars with 7/8-inch by 1/8-inch tension bands (aluminum alloy 6063-T5, ASTM B221) spaced approximately 6 inches apart and to all line posts and rails with No. 6 gauge (.194" diameter) wire ties (aluminum alloy 1100-H18) approximately 6 inches on center.

b. Tension Wires. Tension wires shall be 7-gauge (minimum) galvanized coil spring steel wire.

c. Anchorage Fittings. The aluminum base plates shall be aluminum alloy 6061-T6 (ASTM B221). Anchor bolts shall be 3/4-inch diameter galvanized bolts 8 inches long (ASTM A307). The portions of the aluminum base plate to be in contact with the concrete parapet and the steel anchor bolts shall be thoroughly coated with an approved aluminum impregnated caulking compound.

831.03 CONSTRUCTION METHODS. Pedestrian fence shall be erected in accordance with the details indicated on the Plans. Fence posts shall be set vertical. Maximum post spacing shall be 8'-0”.

The fabric shall be secured with ties, stretchers and tensioning devices sufficiently to resist wind and weather loadings without noticeable sagging, billowing or skewing of the square patterns.

831.03.1 Tolerance. Standard plus or minus mill tolerances on all framework members and chain link fabric will apply.

831.04 METHOD OF MEASUREMENT. "Pedestrian Chain Link Fence - Aluminum" will be measured by the number of linear feet actually installed in accordance with the Plans and/or as directed by the Engineer. Measurement will be along the top of the fence from centerline to centerline of end posts for each continuous run of fence.

831.05 BASIS OF PAYMENT. The accepted quantity of "Pedestrian Chain Link Fence - Aluminum" will be paid for at the contract unit price per linear foot as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, tools and equipment, and all other incidentals required to finish the work, complete and accepted by the Engineer.

SECTION 832

BRIDGE SIGNS

832.01 DESCRIPTION. This work consists of providing bridge identification signs and bridge minimum clearance signs on all bridges that intersect with highways, streets or ramps. Bridges over waterways, railroads or other non vehicular facilities, unless specifically noted, will not require signs. Signs shall be installed for all directions of travel at locations described herein or as directed by the Engineer, all in accordance with these Specifications.

832.02 MATERIALS.

832.02.1 Reflectorized Sheeting. Reflectorized sheeting shall be Type III and shall otherwise conform to the requirements of **Subsection M.16.02** of these Specifications. The colors used shall be white or silver-white for the bridge identifications signs and yellow for the bridge minimum clearance signs.

832.02.2 Aluminum Backing shall conform to the requirements of ASTM B209, Alloy 6061-T6 and shall be 0.063-inch in thickness.

832.02.3 Black Paint shall be a one component lead and chromate free paint suitable for use as a finish coat on the properly prepared reflectorized sheeting surface. The paint color shall meet the Federal Standard Number 595, Color 17038 (gloss black). Manufacturer's Product Data Sheets shall be submitted for approval of the Engineer prior to any use of the product in the manufacture of the signs.

832.02.4 Steel for wedge style anchors, clips, drop-in anchor bodies, and expansion plugs shall meet the requirements of ASTM A108.

832.02.5 Fasteners for attaching bridge signs to fascia girders, either steel or concrete, shall be hammer-driven lead anchors. The anchor consists of a 1/4-inch diameter shaft, 3/4-inch in length. The shaft has a round head at one end approximately ½-inch in diameter. The shaft is split into expandable sections ½-inch from its end. The anchor is provided with a zinc-coated nail, 1⅛-inches long, placed in a hole through the center of the round head and through the solid portion of the shaft.

832.02.6 Plating for components shall be zinc and shall meet the requirements of ASTM B633, SC-1, Type III.

832.03 CONSTRUCTION METHODS.

832.03.1 Location.

a. Bridge Identification Signs. The location of the signs will be as noted on the Plans or as directed by the Engineer. The sign will be placed level on the web of the girder, face of concrete beam, wall or parapet as appropriate. The sign shall be centered vertically and centered above the travel lanes.

b. Bridge Minimum Clearance Signs. The location of the signs and the measured minimum vertical clearance of a particular bridge will be provided by the Resident Engineer. The sign will be placed above a travel lane at the point of minimum vertical clearance. The signs shall be located both horizontally and vertically as close to the actual point of minimum vertical clearance as is practical.

832.03.2 Fabrication. The aluminum sheet shall be cut to the sizes outlined in details shown on the Plans or in standard details. The reflective sheeting shall be placed upon and completely cover the aluminum backing sheet.

The lettering shall be painted in black upon the reflective sheeting as outlined in the details shown on the Plans. All lettering and numerals shall be centered on the sign panel. All letters and numerals shall be drawn in accordance with the "Standard Alphabets for Highway Design" by the U.S. Department of Transportation, Federal Highway Administration, Office of Traffic Operations. All characters for bridge identification signs shall be 8 inches in height using a series "D" stroke (1.25" wide). All characters for bridge minimum clearance signs shall be 12 inches in height using a series E stroke (2.06" wide) for roadways with posted speed limits of forty miles per hour or greater and 8 inches in height using a series E stroke (1.38" wide) for roadways with posted speed limit less than forty miles per hour.

832.03.3 Attachment.

a. Position. Signs shall be positioned on the fascia girders as described above in **Para. a** of **Subsection 832.03.1**. A minimum of four fasteners will be required per sign and they shall be evenly spaced so that the maximum distance between fasteners is no greater than 24 inches.

b. Installation. Signs to be located on steel or concrete fascia girders shall be attached as follows:

1. The sign panels shall be fabricated with 9/32-inch diameter holes as indicated on the Plans.

2. Using the sign panel as a template, locate the center of each hole on the face of the girder.

3. On steel girders, drill a 1/4-inch diameter hole through the girder web. On concrete girders, drill a 1/4-inch diameter hole for a depth of 1⅜-inches. The Contractor shall insure that the length of the fastener does not extend beyond the minimum concrete cover to the reinforcing steel or prestressing steel. If concrete cover becomes a hinderance to fastener selection, then additional fasteners can be utilized.

4. Place the bridge signs against the girder fascias such that the holes line up.

5. Place the lead anchors specified in **Subsection 832.02.5**, above, through the sign and into the holes in the girders.

6. With a hand hammer, drive the nail protruding from the head of the anchor until it is flush with the head.

832.03.4 Approvals. The Contractor shall submit the following for approval by the Engineer.

1. Complete shop drawings of the Bridge Identification Signs and Minimum Clearance Signs demonstrating that the signs comply with these Specifications and the details indicated on the Plans, as applicable. The drawings shall also contain the proposed message for the signs and a bill of materials describing the proposed attachment hardware along with manufacturer's specifications for the proposed hardware.

2. A sketch indicating the specific proposed location of each sign.

832.04 METHOD OF MEASUREMENT. "Bridge Identification Signs" and "Bridge Minimum Clearance Signs" will be measured for payment by the number of each sign installed in accordance with the Plans and/or as directed by the Engineer.

832.05 BASIS OF PAYMENT. The accepted quantities of "Bridge Identification Signs" and "Bridge Minimum Clearance Signs" will be paid for at their respective contract unit prices per each such sign as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, materials and equipment, and for all other incidentals required to finish the work, complete and accepted by the Engineer.

SECTION 833

GRANITE IDENTIFICATION TABLETS

833.01 DESCRIPTION. This work consists of providing granite identification tablets on bridges at the locations indicated on the Plans, all in accordance with these Specifications.

833.02 MATERIALS.

833.02.1 Granite Tablets. Granite shall be fine grained, light gray granite of sound, compact structure, resistant to weathering action, uniform in color, free from seams, cracks, laminations and minerals which by weathering would cause discoloration or deterioration.

a. Additional Requirements. The granite tablets shall conform to the following additional requirements.

1. Granite stone shall conform to the material characteristics and physical requirements of ASTM C615, Standard Specification for Granite Dimension Stone.

2. Finish. Face shall be sand rubbed.

3. Thickness. 2 inches; plus or minus 1/4-inch.

4. Inscriptions. Numerals, letters, and seal shall conform to the type, style and dimensions indicated on the Plans.

(a) Seal Tablets. Seal tablets shall include the Rhode Island State Seal and the year of construction. Numerals shall have a height of 1¾-inches. The type and style of lettering and size of seal shall be approved by the Engineer.

(b) Name Tablets. The letters shall be inscribed having a minimum height of 1¼-inches to a maximum height of 2 inches. Numerals shall have a height of 2 inches.

5. Inscribing. Inscribing letters, numerals and seals shall be by blast abrasive method. Seal, letters, and numerals shall be incised, U-sunk to a depth of approximately ½-inch with all edges clear and sharp. All sunken areas are to be painted with an approved blue acrylic lacquer. Color samples shall be submitted to the Engineer for approval prior to using the lacquer on the sample tablet.

6. Edges; Pitched and Straight. No projection first inch, the remaining depth, plus zero, minus 1/4-inch.

7. Details of 10-inch by 2-inch Granite Identification Tablets.

(a) Face. 10 inches by 14 inches, plus zero, minus 1/4-inch.

b. Shop Drawings. Shop drawings of the Granite Identification Tablets shall be drawn to actual size and shall indicate emblems, inscriptions and all other pertinent information. Shop drawings shall be submitted to the Engineer in accordance with **Subsection 105.02** of these Specifications.

c. Packaging. Identification tablets shall be enclosed in wooden boxes and provided with adequate protection to prevent damage to the stones before installation.

833.02.2 Portland Cement Mortar. Mortar shall conform to the requirements of **Subsection M.04.03.5** of these Specifications.

833.03 CONSTRUCTION METHODS. The granite identification tablets shall be carefully set in a full mortar bed at the indicated locations. The plane of the face of the identification tablets when in final position shall be flush with the plane of the surrounding concrete surface.

833.04 METHOD OF MEASUREMENT. "Granite Identification Tablets" of the types and sizes specified will be measured by the number of each such tablet actually installed in accordance with the Plans and/or as directed by the Engineer.

833.05 BASIS OF PAYMENT. The accepted quantities of "Granite Identification Tablets" of the types and sizes specified will be paid for at their respective contract unit prices per each such tablet as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, materials, tools, equipment, and all other incidentals required to finish the work, complete and accepted by the Engineer.

SECTION 834

GRANITE CURB FOR BRIDGES

834.01 DESCRIPTION. This work consists of providing straight or circular granite curbing at the locations indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications. The two basic types of curbing are described as follows:

a. Vertical Face Granite Curbing.

b. Slope Face Granite Curbing.

834.02 MATERIALS. Granite curb for bridges shall conform to the requirements of **Subsection M.09.05** of these Specifications.

834.03 CONSTRUCTION METHODS. The curb shall be set accurately to line and grade in a full mortar bed and with full mortar end joints before concrete in back of curb is placed. Anchors shall be grouted into curb stones as they are being set. Care should be taken that all spaces under stones and at joints are completely filled.

If indicated on Plans, joints between ends of individual stones shall be raked to dimensions shown on the Plans and sealed with the specified type of joint sealer. Otherwise, joints shall be carefully filled with cement mortar and neatly pointed on top and face. After pointing, curb stones shall be cleaned of all excess mortar to the satisfaction of the Engineer.

When placing concrete behind the curb stones, care should be taken to avoid disturbing line and grade of the stones.

834.04 METHOD OF MEASUREMENT. "Vertical Face Granite Curb Straight," "Vertical Face Granite Curb Circular," "Slope Face Granite Curb Straight," and "Slope Face Granite Curb Circular" will be measured (along the front arris of the curb) by the number of linear feet of such curbing actually installed in accordance with the Plans and/or as directed by the Engineer.

834.05 BASIS OF PAYMENT. The accepted quantities of "Vertical Face Granite Curb Straight," "Vertical Face Granite Curb Circular," "Slope Face Granite Curb Straight," and "Slope Face Granite Curb Circular" will be paid for at their respective contract unit prices per linear foot as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, materials and equipment, and all other incidentals required to finish the work, complete and accepted by the Engineer.

SECTION 835

SCUPPERS

835.01 DESCRIPTION. This work consists of providing scuppers and connections to their drains at the locations indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

835.02 MATERIALS. Scupper frames and grates shall conform to the requirements of **Para. c** and **Para. d**, respectively, of **Subsection M.05.04.9** of these Specifications.

835.03 CONSTRUCTION METHODS. The scupper assembly shall be installed, anchored and supported as shown on the Plans.

835.04 METHOD OF MEASUREMENT. "Scuppers" will be measured by the number of such assemblies actually installed in accordance with the Plans and/or as directed by the Engineer.

835.05 BASIS OF PAYMENT. The accepted quantity of "Scuppers" will be paid for at the contract unit price per each assembly as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials and equipment, and all other incidentals required to finish the work, complete and accepted by the Engineer.

SECTION 836

STRUCTURAL CONCRETE CRACK REPAIR BY EPOXY-RESIN BASE ADHESIVE INJECTION

836.01 DESCRIPTION. This work consists of repairing cracks in concrete by furnishing and injecting epoxy-resin base adhesives into such cracks. The work also includes surface preparation, setting injection ports and cleaning surfaces following repairs. Crack repair work shall be performed at locations indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

836.02 MATERIALS. All products indicated below must be listed in the Department's Approved Materials List.

836.02.1 Injection Material. Injection material shall be a low viscosity, two-part epoxy-resin system conforming to the requirements of ASTM C-881, Type IV. The material shall also be the required grade and class to satisfactorily perform its function.

a. Quality Control. Testing and certification of each lot of the adhesive is required. The manufacturer shall both certify that every batch of the material conforms to the requirements

of this Specification and submit to the Engineer certified test results for each batch.

b. Labeling, Packaging and Storage shall conform to the requirements of ASTM C-881 and shall include the following information:

1. Health hazard warnings, precautions for handling and recommended first aid procedures in case of contact.

2. Mix ratio by volume.

c. Injection Equipment shall be operated either manually or automatically as required by the manufacturer.

d. Surface Seal. A surface seal material as recommended by the adhesive manufacturer shall be used to confine the injection adhesive in the crack during injection and curing. It shall have adequate strength to hold injection fittings or ports and prevent vent leakage during injection.

836.03 CONSTRUCTION METHODS.

836.03.1 Surface Preparation. All deteriorated concrete adjacent to the cracks and areas of application shall be removed prior to proceeding with crack repairs.

Surfaces adjacent to cracks or other areas of application shall be cleaned of dirt, dust, grease, oil, efflorescence or other foreign material matter detrimental to the bond of the epoxy injection - surface seal system. Use of acids or other corrosives will not be permitted. Cleaning methods shall not introduce foreign materials into the crack repair area in such a manner that the penetration of the epoxy adhesive is hindered.

Entry ports shall be provided along the crack at intervals recommended by the manufacturer.

836.03.2 Component Ratio Calibration Test. The mixing head of the injection equipment shall be disconnected and the two adhesive components shall be pumped simultaneously through two independent valved nozzles. Both adhesive components shall be simultaneously discharged during the same time period such that they may be compared to determine the volume.

The Engineer, at any time and without prior notification to the Contractor, may request the Contractor to conduct the calibration test specified above.

836.03.3 Epoxy Injection. Epoxy injection shall be performed in accordance with the manufacturer's recommended methods. If a recommended application procedure is not available, the Contractor shall use the following epoxy injection technique:

a. Injection of epoxy adhesive shall begin at a lower entry port and continue until there is an appearance of epoxy adhesive at the next entry port adjacent to the entry port being pumped.

b. When epoxy adhesive travel is indicated by appearance at the next adjacent port, injection shall be discontinued on the entry port being pumped, and epoxy injection shall be transferred to next adjacent port where epoxy adhesive has appeared.

c. This epoxy adhesive injection procedure shall continue until all cracks within the crack network between the designated port interval are completely filled.

d. If port to port travel of the epoxy adhesive is not indicated, the work shall immediately be stopped and the Engineer notified.

e. Minimum ambient temperature at time of injection shall be 45°F or as recommended by the manufacturer.

f. The applicator engaged in the epoxy injection process shall be familiar with the specific epoxy injection method indicated, as well as the operation, maintenance and trouble shooting of equipment.

836.03.4 Finishing. When cracks are completely filled, epoxy shall be cured for sufficient time in accordance with the manufacturer's recommendations.

Surface seal material and injection adhesive runs or spills shall be removed from concrete surfaces in a manner recommended by the manufacturer and approved by the Engineer.

The face of the crack shall be finished flush to the adjacent surface and show no indentations or protrusions caused by the placement of entry ports.

836.04 METHOD OF MEASUREMENT. "Structural Concrete Crack Repair by Epoxy-Resin Base Adhesive Injection" will be measured by the number of linear feet, port to port, actually repaired in accordance with the Plans and/or as directed by the Engineer.

836.05 BASIS OF PAYMENT. The accepted quantity of "Structural Concrete Crack Repair by Epoxy-Resin Base Adhesive Injection" will be paid for at the concrete unit price per linear foot as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, tools, materials, equipment, including scaffolds, and all other incidentals required to finish the work, complete and accepted by the Engineer.

SECTION 837

REPAIRS TO STRUCTURAL CONCRETE MASONRY WITH INTEGRALLY COLORED CONCRETE OR PATCHING MORTAR

837.01 DESCRIPTION. This work consists of removing all deteriorated, disintegrated, soft, honeycombed, fractured, or otherwise defective concrete and replacing it with integrally colored Portland cement concrete, or Portland cement mortar at locations indicated on the Plans or as directed by the Engineer. The concrete or mortar shall be of a color, texture and have aggregates from approved sources that closely match the predominant color, texture and aggregates of the

existing concrete structure. Repairs shall include, but will not be limited to: removal and disposal of damaged concrete, cleaning and preparing of the bonding surface, cleaning of existing reinforcing steel, placing of additional reinforcing steel where required, application of a bonding agent slurry, and placement of new concrete repair materials to restore the structural elements to the original line, grade, and surface finish (color and texture). The Contractor shall submit a repair plan for each specific type of repair in accordance with the Plans and these Specifications.

837.02 MATERIALS. All proposed repair materials shall conform to the applicable requirements of **Subsection 817.02** of these Specifications and/or be listed on the Department's Approved Materials List.

837.02.1 Aggregate. The fine and coarse aggregates must be approved by the Engineer as to color and texture.

837.02.2 Integrally Colored Concrete. Integrally colored Portland cement concrete shall conform to the applicable requirements of **SECTION 601** of these Specifications. The concrete classification and location used shall be as specified on the Plans and/or as directed by the Engineer.

837.02.3 Integrally Colored Patching Mortar. Patching mortar shall conform to the applicable requirements of **Subsection 817.02.2** of these Specifications except that the maximum water cement ratio shall not exceed 0.40 by weight. The consistency of the mortar shall meet the application requirements.

837.02.4 Coloring Pigment. Coloring pigments for integrally colored concrete or patching mortar shall meet the requirements of ASTM C979 and be approved by the Engineer. Coloring pigments shall be used in accordance with the manufacturer's recommendations.

837.02.5 Portland Cement Bonding Grout Slurry. The bonding grout slurry shall have the cement and mortar sand proportioned 1-to-1 by volume. Water shall be added in sufficient quantity to form a slurry.

837.02.6 Concrete Anchors. Mechanical concrete anchors shall be hooked type expansion bolts galvanized in accordance with the applicable requirements of **Subsection M.05.04.4, Para. d** of these Specifications and shall be of a type approved by the Engineer.

837.02.7 Wire Mesh Reinforcement. Wire mesh shall be galvanized or epoxy coated, in accordance with ASTM A884, welded fabric No. 12 gauge wire (minimum size) spaced two inches in each direction. Wire fabric shall conform to the requirements of **Subsection M.05.02.1** of these Specifications.

837.02.8 Prototype (Samples). The Contractor shall submit to the Engineer a prototype (1'x1'x3" min.) showing color and texture of the concrete and/or mortar required. The Contractor shall also provide, in writing, the mix design and methods for obtaining any required surface finish (i.e., exposed aggregate, etc.) for each material. The prototype(s) must be submitted sufficiently in advance to allow for review and approval of the repair material. The prototypes must be approved in writing by the Engineer and, if necessary, by the Department's Historic Preservation Specialist prior to use in production.

837.03 CONSTRUCTION METHODS. The Contractor shall inspect the structure to acquaint himself with the nature and extent of the work.

Repair of concrete shall be performed with qualified workmen. The Engineer, at his option, shall witness all repair work. The Engineer shall be notified of any repair work no later than 24 hours prior to the scheduled repair work.

837.03.1 Surface Preparation.

a. General Requirements. All deteriorated, disintegrated, soft, honeycombed, fractured, or otherwise defective concrete shall be removed from the areas to be repaired by means of suitable power and hand tools to a uniform depth, sufficient to expose a bonding surface of sound material as determined by the Engineer. Power tools that cause over-breakage of concrete will not be allowed. At the direction of the Engineer, the perimeter of the area to be repaired will be saw cut parallel to the horizontal and/or vertical axis of the element being repaired to a depth of at least 3/4-inch. Thin or feathered edges will not be permitted. Areas to be repaired shall be roughly circular or rectangular in outline. Re-entrant corners and shapes which include acute angles shall be avoided.

In areas where reinforcing steel is found to be surrounded by deteriorated concrete or where at least one-half of the rebar surface area is exposed, the depth of concrete removal shall be such as to include all deteriorated concrete and not less than 1 inch minimum annular clearance around the reinforcing bars. Concrete removal shall extend along the reinforcement to where it is well bonded to sound concrete. All corroded reinforcing bars shall be thoroughly cleaned to remove all rust. Those bars that have lost 20 percent or more of their original cross-sectional area shall be supplemented by new equal diameter bars spliced in place. New bars shall be lapped sufficiently (30 diameters on both sides of the affected area) to develop the full design strength of the bar. If necessary, additional chipping will be required to provide this lap. Dual bars of equivalent or greater section may be used.

Repairs less than 1½-inches thick will not require wire mesh reinforcement unless specified by the Engineer. In cases where the thickness is greater, the Engineer shall, in general, order that wire mesh reinforcement be used every 1½-inches in depth and provide a minimum of 3/4-inch cover. In such cases, after the surface preparation has been approved, concrete anchors to hold the wire mesh reinforcement shall be placed according to Table 1, unless otherwise directed by the Engineer.

Table 1
Size and Spacing of Anchors

Thickness of Placement (in.)	Overhead Surfaces Dia. (in.) Spacing (in.)	Vertical Surfaces Dia. (in.) Spacing (in.)	Top Horizontal Surfaces Dia. (in.) Spacing (in.)
1½ to 4	1/4 at 24	1/4 at 24	1/4 at 36
4 to 5	1/4 at 20	1/4 at 24	1/4 at 36
5 to 6	3/8 at 17	3/8 at 21	3/8 at 36
over 6	3/8 at 16	3/8 at 20	3/8 at 36

All chipped areas, corroded rebars and concrete surfaces to be repaired shall be thoroughly cleaned by means of compressed air, sandblasting, waterblasting, steam, wire brushing or by other methods approved by the Engineer. The Contractor may use one or all of the various means of cleaning chipped areas as approved or as directed by the Engineer.

Once all deteriorated concrete has been removed, the existing sound concrete shall be maintained in a clean, rough, and surface saturated moist condition until the concrete repair has been completed. When an epoxy-resin agent is specified, the prepared sound concrete surface shall be thoroughly dried prior to application of the epoxy-resin.

Care shall be taken during the removal of the designated portions of the structure to avoid damaging the portions that are to remain in place. Any damage caused by the Contractor to the existing structure that is designated to remain in place shall be repaired or replaced by the Contractor at his own expense to the satisfaction of the Engineer.

Mechanical concrete anchors shall be expansion bolts of a type approved by the Engineer. The exposed end of each anchor shall have a means of engaging reinforcement, either mechanical or hooked, and supplemented by the use of coated steel tie wire.

If any reinforcement is damaged by the Contractor in his operations, the bar shall be replaced as required by the Engineer at the Contractor's expense.

b. Forms. Forms shall be used for Portland cement concrete repairs whenever necessary to confine the concrete and shape it to the required lines. Such forms may partially require progressive installation as the concrete is placed as a result of confinements for placing concrete due to the location of the particular repair or restoration required. The forms shall have sufficient strength to withstand the pressure resulting from placing operations, shall be maintained rigidly in position, and shall be sufficiently tight to prevent loss of mortar from the concrete. The use of form oils is expressly forbidden. The Contractor shall use an alternate method or material for facilitating form release that will not cause discoloration or staining of the concrete. All such methods or materials are subject to the approval of the Engineer.

c. Weather Limitations. With respect to temperature and weather conditions, concrete repair materials shall be used in accordance with the applicable requirements of **Subsection Nos. 601.03.4, 601.03.5, and 601.03.6; Limitations of Mixing, Cold Weather Concrete, and Hot Weather Concrete**, respectively.

837.03.2 Application.

a. Prime Coat. Prior to placing the concrete or mortar on a previously prepared and approved concrete surface, the entire area to be patched shall first be given a prime coat using a Portland cement bonding grout slurry.

The consistency of the Portland cement bonding grout slurry shall be such that it can be applied with a brush on a prepared moist concrete surface in a thin (approximately 1/8-inch) even coating that will not run or puddle. Excess bonding grout will not be permitted to collect in pockets. The Portland cement bonding grout shall be applied to the concrete and the surfaces of the reinforcing bars, and into the spaces between the reinforcing bars and the prepared concrete surfaces. Care shall be exercised to ensure that all surfaces receive a thorough, even coating.

The rate of bonding grout application shall be limited to that surface area which can be covered with new concrete or mortar before the bonding grout begins to dry out. Any grout that has dried or become unworkable, as determined by the Engineer, shall not be incorporated in the work. In the event drying does occur, the Contractor shall remove the bonding grout and place new bonding grout. The removal of the bonding grout shall be by a method approved by the Engineer and at the Contractor's expense.

b. Placing and Consolidation. Integrally colored Portland cement concrete shall be placed, consolidated, and finished on a previously prepared surface as described in this Specification and to which a Portland cement bonding grout slurry has been applied.

Integrally colored patching mortar shall be placed in ½-inch to 1-inch lift layers within 5 to 10 minutes after mixing water is added to avoid the rapid setup of the material after the application of the bonding grout slurry.

If more than one lift layer is required to perform the repair, the previously placed lift layer will not be allowed to dry, and its surface shall be roughened prior to placing the next layer.

Patching mortar shall not be applied when the ambient temperature is below 45°F or is not in accordance with the manufacturer's recommendations.

c. Finish. All exposed surfaces shall be finished straight and true, approximating the original contour as close as practicable. The final finished surfaces shall match the texture, color and aggregate exposure of the existing concrete surfaces adjoining or proximate to the area where new concrete has been placed.

The Contractor shall capture all the waste and water from the finishing operations, and dispose these materials. All materials and/or labor costs resulting from the surface finishing operations, including sedimentation and dewatering controls shall be included in this item of work.

d. Curing. Curing procedures and methods shall comply with the color additive manufacturer's recommendations and as set forth in **Subsection 601.03.8; Curing**, of these Specifications, or as otherwise directed by the Engineer. Use of curing compounds is not permitted unless specifically required by the manufacturer of the color additive.

837.04 METHOD OF MEASUREMENT. "Repairs to Structural Concrete Masonry with Integrally Colored Concrete or Patching Mortar" will be measured by the number of cubic feet of such materials actually placed in accordance with the Plans and/or as directed by the Engineer.

837.05 BASIS OF PAYMENT. The accepted quantity of "Repairs to Structural Concrete Masonry with Integrally Colored Concrete or Patching Mortar" will be paid for at the contract unit price per cubic foot as listed in the Proposal. The price so-stated shall constitute full and complete compensation for all materials, labor, equipment, tools, forms, scaffolds, wire mesh, anchors and bonding grout, and all other incidentals required to finish the work, complete and accepted by the Engineer.

Steel reinforcement and dowels shall be paid for under separate items.

SECTION 838

SAW CUT IN EXISTING CONCRETE WALLS

838.01 DESCRIPTION. This work consists of saw cutting existing reinforced concrete retaining walls and/or wingwalls at the locations indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

838.02 MATERIALS. Not applicable.

838.03 CONSTRUCTION METHODS. Two separate horizontal saw cuts, to the limits and depths as shown on the Plans, are required to be made along each wall face to reduce and control the amount of concrete breakage required and to assure a neat line in the finished work. Copings may be cut transversely into smaller pieces or removed in one piece at the option of the Contractor, as long as the concrete to remain is not damaged during the removal operations. The intentions of the saw cut is to cut existing reinforcements at the saw cut lines. Suitable guidelines and devices must be used to assure cutting along a true line, as shown on the Plans. The type of concrete saw and the method of support to be used will be subject to approval by the Engineer.

838.04 METHOD OF MEASUREMENT. "Saw Cut in Existing Concrete Walls" will be measured by the number of linear feet actually cut in accordance with the Plans and/or as directed by the Engineer.

838.05 BASIS OF PAYMENT. The accepted quantity of "Saw Cut in Existing Walls" will be paid for at the contract unit price per linear foot as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, and equipment, and all other incidentals required to finish the work, complete and accepted by the Engineer.

No payment will be made for any transverse saw cuts in walls made in order to divide it into practical lengths for removal.

SECTION 839

REMOVE AND DISPOSE BITUMINOUS CONCRETE PAVEMENT FROM CONCRETE BRIDGE DECKS - PARTIAL-DEPTH AND FULL-DEPTH

839.01 DESCRIPTION.

839.01.1 Partial-Depth Removal. This work consists of the removal and disposal of a portion of the existing bituminous pavement overlay from the concrete bridge deck within the limits indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

839.01.2 Full-Depth Removal. This work shall consist of the complete removal and disposal of the existing bituminous pavement overlay, including the waterproofing membrane, from the concrete bridge deck within the limits indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

839.02 MATERIALS. Not applicable.

839.03 CONSTRUCTION METHODS.

839.03.1 Partial-Depth Removal. The Contractor shall insure that the process of partial pavement removal will not cause any damage to the waterproofing membrane, underlying concrete deck and/or bridge joints to remain. The Contractor shall also insure that the method proposed will remove the specified layer thickness of the bituminous wearing surface as indicated on the Plans. Under no circumstances will full depth removal be allowed. The specifications, including gross weight(s) of the proposed equipment and/or machinery to be used for the removal operation shall be submitted to the Engineer for approval prior to the start of work. The proposed equipment and/or machinery loads shall not exceed 40,000 pounds or the posted load limit for the bridge, whichever is less. In addition, equipment and/or machinery to be used shall have the capability and precision necessary to adhere to the pavement removal depth requirements. Damage caused to the waterproofing membrane, bridge deck and/or bridge joints as a result of the Contractor's operation shall be repaired to the satisfaction of the Engineer at no additional cost to the State.

The pavement removal shall be performed in accordance with the sequence of construction and traffic controls indicated on the Plans. Where required, the Contractor will saw cut the pavement to prevent over-breakage into the vehicular travel areas. In the event that this type of over-breakage does occur, the Contractor shall immediately patch the damaged bituminous areas using a bituminous patching material which conforms with **SECTION 410; TEMPORARY PATCHING MATERIAL**, of these Specifications at no additional cost to the State. The removal operation shall not endanger the general public or interfere with the established traffic maintenance plan.

All materials removed shall be transported from the site and legally disposed of by the Contractor.

839.03.2 Full-Depth Removal. The Contractor shall insure that the process of removal of the pavement and the waterproofing membrane will not cause any damage to the underlying concrete deck and/or bridge joints to remain. The Contractor shall also insure that the method proposed will completely remove the existing waterproofing membrane to allow for the proposed deck patching repairs and new waterproofing system installation. The Contractor will note that the thickness of the existing pavement may vary. The specifications, including gross weight(s) of the proposed equipment and/or machinery to be used for the removal operation, shall be submitted to the Engineer for approval prior to the start of work. The proposed equipment and/or machinery loads shall not exceed 40,000 pounds or the posted load limit for the bridge, whichever is less. Damage caused to the deck and/or bridge joints as a result of the Contractor's operation shall be repaired to the satisfaction of the Engineer at no additional cost to the State.

The pavement and waterproofing removal shall be performed in accordance with the sequence of construction and traffic controls indicated on the Plans. Where required, the Contractor will saw cut the pavement to prevent over-breakage into the vehicular travel areas. In the event that this type of over-breakage does occur, the Contractor shall immediately patch the damaged bituminous areas using a bituminous patching material which conforms with **SECTION 410; TEMPORARY PATCHING MATERIAL**, of these Specifications, at no additional cost to the State. The removal operation shall not endanger the general public or interfere with the established traffic maintenance plan.

All materials removed must be transported from the site and legally disposed of by the Contractor.

839.04 METHOD OF MEASUREMENT. "Partial-Depth Removal and Disposal of Bituminous Pavement from Concrete Bridge Decks" and "Full-Depth Removal and Disposal of Bituminous Pavement from Concrete Bridge Decks" will be measured by the number of square yards of each actually removed in accordance with the Plans and/or as directed by the Engineer.

839.05 BASIS OF PAYMENT.

839.05.1 Partial-Depth Removal. The accepted quantity of "Partial-Depth Removal and Disposal of Bituminous Pavement from Concrete Bridge Decks" will be paid for at the contract unit price per square yard as set forth in the Proposal, which price will constitute full compensation for the complete removal and disposal of bituminous pavement, and all materials, labor, tools, equipment, saw cutting, and all other incidentals necessary for the proper completion of the work specified, shown on the Plans, complete and accepted by the Engineer.

839.05.2 Full-Depth Removal. The accepted quantity of "Full-Depth Removal and Disposal of Bituminous Pavement from Concrete Bridge Decks" will be paid for at the contract unit price per square yard as set forth in the Proposal, which price will constitute full compensation for the complete removal and disposal of bituminous pavement, including waterproofing membrane, and all materials, labor, tools, equipment, saw cutting, and all other incidentals necessary for the proper completion of the work specified, shown on the Plans, complete and accepted by the Engineer.

SECTION 840

DECK SURFACE CONCRETE REMOVAL BY HYDRODEMOLITION

840.01 DESCRIPTION. This work consists of the removal of deteriorated concrete from reinforced concrete bridge deck surfaces by the use of hydrodemolition methods, the provision of adequate containment measures under the bridge deck, the control and diversion of runoff during the hydrodemolition operations, disposal of all concrete and other materials removed by hydrodemolition, and all other incidentals as necessary to complete the work in accordance with the requirements of these Specifications.

840.02 EQUIPMENT. The hydrodemolition equipment shall consist of filtering and pumping units operating in conjunction with a remote controlled robotic device, and if applicable, shall be capable of using river, stream or lake water. The withdrawal of water from any body of water under the jurisdiction of the RI Department of Environmental Management (RIDEM) or the Coastal Resources Management Council (CRMC) shall not be permitted unless such use is authorized by a permit issued by the appropriate regulatory agency.

The hydrodemolition equipment shall be capable of producing a water jet through an orifice at a pressure of at least 17,000 psi. The machine shall move the jet transversely across the area and forward or backward so that the entire deck is exposed to the water jet. The movement of the jet shall be accomplished by mechanical means; no manual movement of the water jet will be allowed except at inaccessible areas such as, but not limited to, proximity to the curb and temporary barriers, and at bridge deck expansion joints.

The equipment shall operate at a noise level of less than 90 decibels at a distance of 50 feet from either the powerpack unit or the remote robot.

840.02.1 Controls. The hydrodemolition equipment shall have sufficient controls to control and vary the following functions of the machine:

a. Water pressure,
b. Angle and distance of the orifice relative to the deck surface,
c. Limits of transverse and longitudinal movement of the orifice,
d. Speed of the orifice in the transverse and longitudinal direction.

840.02.2 Submissions and Qualifications. Post-qualification by the Engineer of the hydro-demolition operation is required. The Contractor shall be responsible for any delay if the post-qualification criteria are not satisfied.

The Contractor shall submit the required post-qualification information on the hydro-demolition operations for approval by the Engineer. The Contractor may submit more than one set of documentation.

a. Minimum Requirements. The post-qualification documentation shall include, as a minimum, the following:

1. The name and location of all projects completed, a brief description of work performed, equipment specifications, estimated production rates, and references of personnel.

2. Specifications for all equipment to be used for the concrete removal, surface preparation and clean-up operations.

3. Anticipated rate of production.

4. An inventory of all common spare parts and replacement accessories required for the equipment.

5. Number of personnel, machine operators and supervisors, and their relevant experience.

6. Proposed method and sequencing of operation for all phases of the concrete removal and surface preparation operations.

The above post-qualification criteria shall apply regardless of the arrangements made by the Contractor to accomplish the hydrodemolition work. It shall be the Contractor's responsibility to insure that subcontractors meet the above post-qualification requirements.

Approval of the hydrodemolition requirements by the Engineer shall not relieve the Contractor of any of his responsibility under the Contract for the timely and successful completion of the work.

840.02.3 Shielding Requirement. Shop drawings showing details, design and catalog cuts for the temporary protective shield system shall be submitted to the Engineer for approval at least thirty (30) days prior to starting work. This shield system is to protect pedestrians, vehicle and/or railroad traffic and utility infrastructure, and to insure that no material or debris associated with the hydrodemolition operation falls below the structure. This system shall be designed for the anticipated weight of all material to be supported.

840.03 CONSTRUCTION METHODS. The concrete shall be removed by hydrodemolition equipment which produces a high pressure water stream capable of removing concrete, asphalt, oil, dirt, concrete laitance and rust from the exposed reinforcing bars by direct impact. Rotary milling or mechanical abrading machines will not be allowed.

The Contractor shall comply with all applicable regulations and permit requirements with respect to the use and disposal of water for hydrodemolition operations.

840.03.1 Concrete Removal. The hydrodemolition equipment shall be adjusted such that the depth of concrete removed from areas of "sound" concrete is approximately ½ inch or as specified on the Plans. In areas where deteriorated concrete is encountered, the removal depth shall be established by the Engineer.

The trial test procedure used to assure that the correct amount of sound concrete is removed by the hydrodemolition machine shall be as follows: The Engineer will locate and record the limits of a trial test of sound concrete approximately 30 square feet in size. An area of sound concrete shall be defined as an area free from chemical defects, delamination, spalling and/or cracking. To locate and identify the area of sound concrete, the Contractor shall, in the presence of the Engineer and following the removal of the bituminous wearing surface, test the deck surface for soundness. Chain dragging, tapping with a hammer or other means of testing approved by the Engineer will be required. The hydrodemolition machine will then be advanced over this area and the operating parameters adjusted to remove 2 inches of sound concrete with in the test area. The depth of concrete removal shall be measured by the Engineer. If the adjustment is such that the machine is removing too much or too little concrete, the machine will be calibrated and the above procedure shall be repeated as many times as necessary to achieve the required depth. One (1) test shall be performed for each stage of deck surface concrete removal, as shown on the Contract Drawings.

The equipment shall be operated by qualified personnel certified by the equipment manufacturer. Operator certification shall be submitted to the Engineer for approval before beginning the concrete removal operation.

The Contractor shall have available service personnel and an inventory of common wear parts and replacement accessories for the equipment to guarantee that the removal operation will not be interrupted for an extended period of time in the event of an equipment breakdown.

A list of operating parameters to be used for the hydrodemolition work shall be submitted to the Engineer prior to the commencement of concrete removal.

Once the operating parameters are established by programming or calibration, they shall not be changed as the machine progresses across the bridge deck except to prevent unnecessary removal of sound concrete below the required minimum removal depth. If, in the opinion of the Engineer, after calibrating the hydrodemolition equipment and beginning production work in a particular area, insufficient removal of concrete is being obtained, the Contractor shall re-calibrate the equipment for that area to assure removal of concrete to the specified depth.

Any areas of the prepared surface contaminated as a result of the Contractor's operations by oil or other materials detrimental to maintaining a good bond shall be removed to such depth as may be required. Such cleaning or removal shall be performed at no additional cost and the Contractor shall be responsible for any resulting delays.

840.03.2 Control of Debris and Water. The Contractor shall provide structurally adequate shields, to be approved by the Engineer, so that the water jet and broken concrete will not be a hazard to workers, traffic on adjacent lanes, or pedestrians and property in areas below or adjacent to the bridge. The water shall be continually drained from the bridge and shields so that excess water will not accumulate, in a manner that will not damage the area below the bridge. Broken concrete, asphalt and all other debris shall be removed and transported from the site and legally disposed of by the Contractor.

All debris shall be removed immediately following the hydrodemolition operation by employing a vacuum recovery system to prevent re-bonding to the remaining surface. Any debris which is allowed to resettle or re-bond to the surface of the sound concrete shall be removed by the Contractor at no extra cost to the State. Special care shall be exercised to avoid damage to the remaining sound concrete and reinforcing steel.

Methods for the Control, Maintenance, and Disposal of Hydrodemolition Runoff shall conform to the requirements of **SECTION 214** of these Specifications.

The runoff control features shall be in place and operational prior to beginning concrete removal. Runoff shall be prevented from running across travel lanes, into bridge drainage devices or into areas below or adjacent to the bridge, except for the containment basin.

840.03.3 Reinforcing Steel. Following the hydrodemolition operation, all exposed reinforcing steel shall be inspected to insure that it has been cleaned of all rust and corrosive products, including oil, dirt, concrete fragments, laitance, loose scale and other coatings of any character

that would destroy or inhibit the bond with the new concrete. Exposed reinforcing steel not adequately cleaned by the initial hydrodemolition process shall be re-cleaned to the satisfaction of the Engineer. If in the opinion of the Engineer, the bars are deteriorated such that they have lost 1/4 or more of their original diameter, the Contractor shall replace the steel as specified in accordance with the provisions of either the Contract or **SECTION 818; PORTLAND CEMENT CONCRETE BRIDGE DECK REPAIR**, of these Specifications.

When cleaned reinforcing steel is exposed for more than seven (7) calendar days, measures shall be taken by the Contractor to protect the steel from contamination by the type of materials indicated above. Reinforcing steel contaminated as a result of the Contractor's failure to provide adequate protection shall be re-cleaned at no extra cost to the State; any resulting delay shall be the Contractor's responsibility. A light coating of rust can be expected to form on the reinforcing; this shall not be considered to constitute contamination.

840.03.4 Concrete Placement. The placement and finishing of concrete for deck repairs and deck overlays shall be as specified in **SECTION 818; PORTLAND CEMENT CONCRETE BRIDGE DECK REPAIR**, of these Specifications.

840.04 METHOD OF MEASUREMENT. "Deck Surface Concrete Removal by Hydrodemolition" will be measured by the number of square feet of deck surface actually removed in accordance with the Plans and/or as directed by the Engineer.

840.05 BASIS OF PAYMENT. The accepted quantity of "Deck Surface Concrete Removal by Hydrodemolition" will be paid for at the contract unit price per square foot as listed in the Proposal. The price so-stated shall constitute full compensation for the removal of the bridge deck surface concrete to the limits shown on the Contract Drawings, including all labor, equipment, tools, design and installation of protective shields, runoff diversion and all incidentals necessary for proper completion of the work specified and shown on the Plans, complete and accepted by the Engineer. No additional payment shall be made for the removal of deteriorated concrete in excess of 2 inches with the hydrodemolition equipment unless specified on the Plans, or for any miscellaneous trim work along the curb, temporary barriers, or on the deck, as required to fulfill the requirements of this Specification.

PART 900

INCIDENTAL CONSTRUCTION AND SERVICES

SECTION 901

STEEL BEAM GUARDRAIL

901.01 DESCRIPTION. This work consists of providing galvanized coated steel beam guardrail and end sections of various types and configurations at the locations indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

901.02 MATERIALS.

901.02.1 Metal Beam Rail. Metal Beam Rail shall conform to the applicable requirements of **Subsection M.08.03** of these Specifications.

901.02.2 Guardrail Posts. Guardrail Posts shall conform to the applicable requirements of **Subsection M.08.07** of these Specifications.

901.02.3 Guardrail Hardware. Hardware shall conform to the applicable requirements of **Subsection M.08.08** of these Specifications.

901.03 CONSTRUCTION METHODS.

901.03.1 Installation.

a. Posts. Posts shall be set plumb and in alignment with the rail elements.

1. Steel Posts, with the exception of end anchor posts, shall be mechanically driven. Where boulders or other unsuitable materials are encountered in driving, such material shall be removed and replaced with suitable material to permit the setting of the post. Where ledge is encountered, the post shall be installed as indicated on the Plans or as directed by the Engineer.

In driving steel posts, suitable driving caps and equipment shall be provided to prevent battering or injury to the posts and to prevent the galvanizing on the posts above the ground line from being scratched, defaced or damaged.

2. Wood Posts shall be set in dug holes or driven, and the area adjacent to the post shall be backfilled and thoroughly compacted.

Wood posts used in guardrail anchorage approach sections shall be installed as indicated on the Plans. Any surplus material remaining after the completed installation shall be removed and legally disposed of by the Contractor.

The Contractor is cautioned that within the limits of any project, buried electrical cable for illumination or utilities may be present.

b. Rail Elements. Rail elements, including brackets, rub rails, and backup rails where required, shall be erected to produce a smooth, continuous installation, all as indicated on the Plans. Terminal sections, rub rails and rail elements shall be lapped in the direction of traffic.

All bolts, except adjustment bolts, shall be drawn tight. Bolts shall be of sufficient length to extend beyond the nuts.

c. End Sections. When excavating for buried anchorages, the trench shall be excavated so that the back face of the "dead-men" anchor is forced against the undisturbed material where this is practical. The wire rope for all anchorages shall be drawn taut and fastened securely.

Before the installation of longitudinal guardrail (parallel to traffic) begins, the required end sections shall be in place. An unprotected blunt end facing traffic will not be permitted. By the end of each working day, blunt trailing ends must be buried in either earth or earth embankment such that the tip of the rail is at least 6 inches below ground or mound level. The blunt end may also be protected by an approved fitch barrel pattern when so indicated on the Plans or directed by the Engineer. All costs associated with the protection of blunt trailing ends shall be incurred by the Contractor at no additional costs to the State.

d. Reflectorized Triangular Delineators. Silver reflectors shall be installed on the right side of the road and amber on the left side, all in accordance with MUTCD Guidelines for Pavement Edgeline Markings. The reflectorized aluminum washer is to be placed in the valley of the beam when mounting beam onto each sixth post.

901.03.2 Cut Galvanized Elements. Before final erection, all galvanized elements which have been cut or worked so as to destroy the zinc coating and cause the base metal to be exposed shall have the exposed base metal thoroughly cleaned and painted with one coat of zinc dust-zinc oxide paint and a finish coat of aluminum paint.

901.04 METHOD OF MEASUREMENT.

901.04.1 Steel Beam Guardrail. "Steel Beam Guardrail" of the various types indicated will be measured by the number of linear feet, end-to-end of continuous sections, actually installed in accordance with the Plans and/or as directed by the Engineer.

901.04.2 Guardrail Posts in Ledge. When required, "Guardrail Posts in Ledge" will be measured by the number of such posts actually installed in accordance with the Plans and/or as directed by the Engineer.

901.04.3 End Sections. "End Sections" of the various types indicated will be measured by the number of such sections actually installed in accordance with the Plans and/or as directed by the Engineer.

901.05 BASIS OF PAYMENT.

901.05.1 Steel Beam Guardrail. The accepted quantities of "Steel Beam Guardrail" of the various types and configurations indicated on the Plans will be paid for at the respective contract unit prices per linear foot as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, materials and equipment, including hardware, nuts, bolts, washers, splice plates, reflectorized triangular delineators, posts driven in earth, and all other incidentals required to finish the work, complete and accepted by the Engineer.

901.05.2 Guardrail Posts in Ledge. The accepted quantities of "Guardrail Posts in Ledge" will be paid for at the contract unit price per each as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials and equipment, including rock excavation and all other incidentals required to finish the work, complete in place and accepted by the Engineer.

901.05.3 End Sections. The accepted quantities of "End Sections" of the various types and configurations indicated on the Plans will be paid for at their respective contract unit prices per each as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, materials and equipment, including hardware, nuts, bolts, washers, splice plates, and all other incidentals required to finish the work, complete in place and accepted by the Engineer.

SECTION 902

STEEL BACKED TIMBER GUARDRAIL

902.01 DESCRIPTION. This work consists of providing steel backed timber guardrail and terminal sections of various types and configurations at the locations indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

902.02 MATERIALS.

902.02.1 Timber Rail, Blocks and Posts. Timber items shall be pressure-treated sawn structural lumber, either spruce or fir, and shall conform to the requirements of AASHTO M168; Standard Specifications for Wood Products, and the applicable requirements of **Subsections M.08.04** and **M.11.01** of these Specifications.

902.02.2 Guardrail Hardware Items. Hardware items shall include all metal fastenings required for timber connections or for connecting timber to concrete or steel, and shall conform to the requirements of **Subsections M.05.04.13** and **M.08.08** of these Specifications, unless otherwise specified. Hardware items shall include such items as bolts, washers, nuts, tie rods, turnbuckles and other items as specified. Unless otherwise specified, hardware items shall be galvanized in accordance with **Subsection M.05.04.13, Para. e** of these Specifications.

Steel backing plates, unless otherwise specified, shall be carbon steel conforming to AASHTO M270 (ASTM A709) Grade 36.

902.02.3 Terminal Sections and Anchor Sections. Earth berms for Type 1 terminal sections shall consist of gravel borrow and a plantable soil and seed cover conforming respectively to the requirements of **Subsections 202.02.2, L.01.01.2** and **L.02.01** of these Specifications.

Cast-in-place concrete anchor sections specified for the Type 1 and Type 2 terminal section shall be Class A(AE) concrete meeting the applicable requirements of **SECTION 601** of these Specifications. Reinforcing steel shall meet the provisions of **Subsection M.05.01** of these Specifications.

902.03 CONSTRUCTION METHODS. Installation of the guardrail items, including the terminal sections, shall be in accordance with the Plans and the applicable provisions of **Subsection 901.03** of these Specifications.

Earth berms at terminal sections shall be constructed in accordance with the Plans and shall consist of the placement and compaction of the gravel borrow and the placement of the plantable soil and seed cover in accordance with **Subsection L.02.03.2** of these Specifications.

902.04 METHOD OF MEASUREMENT.

902.04.1 Steel Backed Timber Guardrail. "Steel Backed Timber Guardrail" will be measured by the number of linear feet, end-to-end of continuous sections, actually installed in accordance with the Plans and/or as directed by the Engineer.

902.04.2 Steel Backed Timber Guardrail Terminal Sections. "Steel Backed Timber Guardrail Terminal Sections" of each type specified will be measured by the number of sections actually installed in accordance with the Plans and/or as directed by the Engineer.

902.05 BASIS OF PAYMENT.

902.05.1 Steel Backed Timber Guardrail. The accepted quantity of "Steel Backed Timber Guardrail" will be paid for at the respective contract unit price per linear foot as listed in the Proposal. The price so-stated shall constitute full and complete compensation for all labor, materials and equipment, including timber rail, timber posts, steel plates, guardrail hardware items including nuts, bolts, washers and splice plates, and all other incidentals required to finish the work, complete in place and accepted by the Engineer.

902.05.2 Steel Backed Timber Guardrail Terminal Sections. The accepted quantities of each type of "Steel Backed Timber Guardrail Terminal Sections" will be paid for at their respective contract unit prices per each as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, materials and equipment, including all earthwork, excavation, trimming and fine grading, landscape items, guardrail hardware items, concrete, and all other incidentals required to finish the work, complete and accepted by the Engineer.

SECTION 903

FENCES

903.01 DESCRIPTION. This work consists of providing woven wire fence of the chain link design, including gates, posts and post foundations, hardware and appurtenances, of various types and configurations at the locations indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

903.02 MATERIALS. Materials for chain link fences, gates, posts and post foundations, hardware and appurtenances shall conform to the applicable requirements of **SECTION M.08; FENCE AND GUARDRAIL**, of these Specifications.

903.03 CONSTRUCTION METHODS.

903.03.1 General. The Contractor shall perform such clearing as may be necessary to construct the fence to the required grade and alignment. At locations of small streams or drainage ditches where it is not practical to conform the fence to the general contour of the ground surface, the Contractor, when directed, shall span the opening below the fence with wire fastened to stakes of such length as required. The new fence shall be permanently tied to the terminals of existing fences whenever required by the Engineer. When directed, the Contractor will be required to stake down the chain link fence at several points between posts. At each location where electric transmission or distribution lines cross any of the types of fences covered by this Specification, the Contractor shall furnish and install a ground conforming to the requirements of Section 9 of the National Electric Safety Code.

903.03.2 Installing Posts. Posts shall be set in Class A(AE) concrete, unless otherwise specified on the Plans. When the Plans require that posts, braces or anchors be imbedded in concrete, the Contractor shall install temporary guys, or braces, as may be required to support the posts in proper position until such time as the concrete has set sufficiently to anchor said posts. No materials shall be installed on posts or strain placed on guys and bracing that are set in concrete until directed by the Engineer. Concrete footings shall be carried to the depth and dimensions shown on the Plans.

Where rock is encountered within the required depth to which the post is to be erected, a hole of a diameter slightly larger than the largest dimension of the post shall be drilled into the rock and the post grouted in. The regular dimensioned concrete footing as shown on the Plans shall then be placed between the top of the rock and required grade shown on the Plans.

All hollow pipe and tube type post shall be fitted with post tops. The bases of the post tops shall have flanges which fit around the outside of the posts and shall be secured.

Unless otherwise specified, tension wires shall be used in sections of chain link fence. The top and bottom tension wire shall be placed, stretched taut, and secured at ends to all posts in a satisfactory manner before fabric is placed.

903.03.3 Installing Fabric. The fabric shall be unrolled on the outside of the fence line with the bottom edge of the fabric against the posts. The various rolls shall be spliced by bringing the

ends close together and weaving in a picket in such a way that will engage both ends of the rolls and catch, with each twist, each separate mesh of the picket of both rolls of fabric.

At end, corner or gate posts, the stretcher bar shall be slipped through the end picket of the fabric and the stretcher bar bands at the same time. The bolts in the stretcher bar bands shall then be tightened. Additional rolls of fabric shall be spliced and placed as the erection progresses along the fence. In long sections, the fence shall be stretched at intervals of about 100 feet.

The fabric shall be placed by securing one end and applying sufficient tension to remove all slack before making attachments elsewhere. After the fabric has been stretched, it shall be tied to the tension wire with fabric ties spaced not more than 24 inches apart. The fabric shall then be attached to the line posts with fabric ties spaced not more than 14 inches apart. The topmost clip shall be placed on the line post as near the top of the fabric as possible, and the lowest clip as near the bottom of the fabric as possible. At terminal sections (end, corner and pull) and gate posts, the fabric shall be fastened with stretcher bars and bands. The fastenings shall be spaced not more than 14 inches on centers for terminal sections (end, corner and pull) and gate posts. The topmost band shall be placed on these posts as near the top of the fabric as possible and the lowest band as near the bottom as possible.

Before making a closure, the other end of the run shall be fastened to the end, corner, or gate post as described previously. The operation of making a closure of a run shall be as follows. The stretching equipment shall be clamped on the ends of the fabric parallel to each other and about 5 feet apart when the tension is first applied. The stretching shall continue until the slack has been removed from both sections of the fabric. If the ends overlap, the fabric shall be cut to match. The ends shall be joined by the insertion of a picket similar to the methods of connecting two rolls of fabric.

903.03.4 Braces. When top rail is not used, braces shall be placed 12 inches down from the top of the terminal posts and shall extend from the terminal (end, corner, and pull) post and gate posts to the brace post. The braces shall be securely fastened to the post and trussed from brace post back to terminal post with round rod and turnbuckle, all as shown on the Plans.

903.03.5 Gates. The gates shall be hung on gate fittings as shown on the Plans. The lower hinge (ball and socket type) shall be placed on top of the concrete in which the gate post is set. The sockets for the cone and foot bolt shall be set in concrete so that the plunger pin will fit perfectly in the socket when the gate is in a closed position. Gates shall be so erected as to swing in the direction indicated and shall be provided with gate stops as specified and as shown on the Plans. Gates shall be erected in suitable places as directed by the Engineer or as shown on the Plans. All hardware shall be thoroughly secured, properly adjusted and left in perfect working order. Hinges and diagonal bracing in gates shall be adjusted so that gates will hang level.

903.03.6 Existing Fence Connection. Wherever a new fence joins an existing fence, either at a corner or at the intersection of straight line fences, the corner post with brace post shall be set at said junction and braced the same as herein described for corner posts or as shown on the Plans. If the connection is made at other than the corner of the new fence, the last span of the old fence shall contain a brace span.

903.04 METHOD OF MEASUREMENT.

903.04.1 Fence. "Fence" of the various types indicated will be measured in linear feet, end-to-end along the top of fence, of continuous sections actually installed in accordance with the Plans and/or as directed by the Engineer.

903.04.2 Gates. "Gates" of the various types and sizes indicated will be measured by the number of such units actually installed in accordance with the Plans and/or as directed by the Engineer.

903.04.3 Post Holes in Ledge. "Post Holes in Ledge" will be measured by the number of such holes actually installed in accordance with the Plans and/or as directed by the Engineer.

903.05 BASIS OF PAYMENT.

903.05.1 Fence. The accepted quantities of "Fence" of the various types and at the respective contract unit prices per linear foot as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, materials, and equipment, including clearing and all other incidentals required to finish the work, complete and accepted by the Engineer.

903.05.2 Gates. The accepted quantities of "Gates" of the various types and sizes indicated on the Plans will be paid for at the respective contract unit prices per unit as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, materials, and equipment, and all other incidentals required to finish the work, complete and accepted by the Engineer.

903.05.3 Post Holes in Ledge. The accepted quantities of "Post Holes in Ledge" will be paid for at the contract unit price per each as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, and equipment, including non-shrink grout or leadite backfill, and all other incidentals required to finish the work, complete and accepted by the Engineer.

SECTION 904

REMOVE AND RESET FENCE

904.01 DESCRIPTION. This work consists of the dismantling, rehandling, stockpiling and removing such sections of fence as are indicated on the Plans and the subsequent resetting of said fence at new locations indicated on the Plans or directed by the Engineer, all in accordance with these Specifications.

904.02 MATERIALS. The materials dismantled and removed shall be utilized in the fence as it is reset, except, where necessary, new materials including new posts, shall be furnished by the Contractor.

New and replacement materials necessary for the proper reconstruction of fences shall conform to **SECTION M.08; FENCE AND GUARDRAIL**, of these Specifications.

904.03 CONSTRUCTION METHODS.

904.03.1 Dismantling. Fence rails, gates, fittings, anchorages and appurtenances and materials suitable for reuse shall be carefully dismantled and detached from the posts, and neatly stored and protected from damage. The Contractor shall replace, at his own expense, any post or other material damaged by its methods of dismantling and removing operations. All salvaged material shall be cleaned, stored and protected until it is reset.

All post holes and other holes caused by excavation under this item shall be backfilled with approved granular material and thoroughly compacted. If post holes are located in a paved area the material shall be replaced in kind.

904.03.2 Resetting. The fence shall be reset plumb in accordance with both the details indicated on the Plans and the requirements for new work of the same or similar type as set forth in other sections of these Specifications. Where conflicts exist, the directions of the Engineer shall govern.

Backfilling around the fence posts shall consist of the placement of approved granular material that is thoroughly compacted. If the fence posts were originally set in cement concrete they shall be reset in their new locations in concrete. Galvanized fence materials and fittings will not be required to be painted unless otherwise indicated on the Plans or as directed by the Engineer.

Post holes in ledge shall be constructed in accordance with **Subsection 903.03.2; Installing Posts,** of these Specifications.

904.04 METHOD OF MEASUREMENT.

904.04.1 Remove and Reset Fence. "Remove and Reset Fence" will be measured in linear feet, outside to outside of end posts of fence actually installed in accordance with the Plans and/or as directed by the Engineer.

904.04.2 Post Holes in Ledge. “Post Holes in Ledge" will be measured by the number of such holes actually installed in accordance with the Plans and/or as directed by the Engineer.

Fence posts unsuitable for resetting through no fault of the Contractor shall be replaced with new posts and said new posts shall be measured for payment by the actual number of such posts furnished and installed.

904.05 BASIS OF PAYMENT.

904.05.1 Remove and Reset Fence. The accepted quantities of "Remove and Reset Fence" will be paid for at the contract unit price per linear foot as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, equipment, backfill,

pavement patch, and clearing, and all other incidentals required to finish the work, complete and accepted by the Engineer.

The accepted quantities of "Fence Posts Replaced" will be paid for at the contract unit price per each as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, and equipment, and all other incidentals required to finish the work, complete in place and accepted by the Engineer.

904.05.2 Post Holes in Ledge. The accepted quantities of "Post Holes in Ledge" will be paid for at the contract unit price per each as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, equipment, including non-shrink grout or leadite backfill, and all other incidentals required to finish the work, complete and accepted by the Engineer.

SECTION 905

SIDEWALKS AND DRIVEWAYS

905.01 DESCRIPTION. This work consists of constructing sidewalks and driveways on prepared gravel bases at the locations indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

Sidewalks and driveways may be constructed of either bituminous concrete or Portland cement concrete, as indicated on the Plans.

905.02 MATERIALS.

905.02.1 Portland Cement Concrete. Portland cement concrete for sidewalks, typical driveways and commercial driveways shall conform to the requirements as set forth in **Subsections 601.01.1; Classification, and 601.03.1; Proportioning**, of these Specifications.

905.02.2 Bituminous Concrete. Bituminous concrete for sidewalks and driveways shall be Type I-2 and Type I-1, respectively, and shall conform to the applicable requirements of **Subsection 401.02** of these Specifications. Coarse and fine aggregates, mineral filler, and asphalt cement shall be combined to produce sidewalk and driveway pavements in accordance with the requirements listed under the column heading entitled, "CLASS I-2 or SIDEWALK" in **Subsection M.03.01** of these Specifications. Performance-graded asphalt cement shall conform to the requirements of **Subsection M.03.02.1** of these Specifications.

905.02.3 Other Materials.

a. Gravel Borrow shall conform to the requirements set forth in **Subsection M.01.02** of these Specifications.

b. Reinforcing, when required, shall be wire-fabric that conforms to the requirements of **Subsection M.05.02.1** of these Specifications.

905.03 CONSTRUCTION METHODS.

905.03.1 Scheduling Sidewalk Construction. Unless directed otherwise by the Engineer, the Contractor shall schedule sidewalk construction activities such that no areas are left without paved sidewalks for more than seven consecutive working days. This means that once the Contractor commences the removal of existing sidewalks at any location within the project, the construction of new sidewalks at that particular location must be completed within seven consecutive working days. To maintain a portion of the existing sidewalk while replacing or resetting curb, the Contractor shall, when indicated on the Plans or directed by the Engineer, saw cut and remove the existing sidewalk 2 feet behind the face of the curb and complete all curb-related activities prior to removing the remaining sidewalk area. Removal of sidewalks shall be performed in accordance with the provisions of **Subsection 201.03.7** of these Specifications.

905.03.2 Compliance with the Americans with Disabilities Act. To comply with the requirements of the Americans with Disabilities Act (ADA), sidewalks shall provide a minimum clearance of 36 inches of width at point of narrowing, excluding the curb width, and 48 inches of continuous width elsewhere. The Contractor shall verify with the Engineer that these requirements can be met prior to completing the construction of new sidewalks. Under no circumstances shall any sidewalks be constructed without prior approval of the Engineer if it is determined that these requirements cannot be attained.

905.03.3 Portland Cement Concrete Sidewalks and Driveways.

a. Excavation. Excavation shall be made to the required depth and to a width that will permit the installation and bracing of the forms. All existing material, including gravel borrow, shall be excavated to the limits indicated on the Plans.

The foundation shall be shaped and compacted to a firm even surface conforming to the section shown on the Plans. All unsuitable material shall be removed and replaced with acceptable material.

b. Gravel Borrow Subbase. The gravel base shall be placed in layers not over 6 inches in depth and compacted to the specified depth below finish grade.

c. Forms. Forms shall be of wood or metal and shall extend for the full depth of the concrete. All forms shall be straight, free from warp and of sufficient strength to resist the pressure of the concrete without springing. Bracing and staking of forms shall be such that the forms remain in both horizontal and vertical alignment until their removal.

d. Placing Concrete. The foundation shall be thoroughly moistened immediately prior to the placing of the concrete. The proportioning, mixing and placing of the concrete shall be in accordance with the requirements for the class of concrete specified.

e. Finishing. The surface shall be finished with a wooden float. No plastering of the surface will be permitted. All outside edges of the slab and all joints shall be edged with a 1/4-inch radius edging tool.

f. Joints. Expansion joints shall be of the dimensions specified, and shall be filled with an approved type of premoulded expansion joint filler. Sidewalks and driveways shall be divided into sections by dummy joints formed by a jointing tool or other acceptable means as directed.

These dummy joints shall extend into the concrete for at least 1/3 of the depth and shall be approximately 1/8-inch wide. At no time shall the distance between transverse and/or longitudinal dummy joints exceed 5 feet.

Construction joints shall be formed around all appurtenances such as manholes, utility poles, etc., extending into and through the sidewalk. Premoulded expansion joint filler 1/4-inch thick shall be installed in these joints. Expansion joints shall be placed every 20 feet. The forcing of premoulded expansion joint filler into freshly placed concrete will not be allowed.

Expansion joint filler shall be installed between concrete sidewalks and any fixed, smooth structure such as a building or bridge. This expansion joint material shall extend for the full depth of the walk. If the sidewalk abuts an irregular wall, foundation or stationary object, the expansion joint filler shall be placed 4 inches from the irregular surface and concrete placed between the irregular surface and the expansion joint material.

The maximum tolerance for the 4-inch concrete thickness is plus-or-minus ½-inch.

g. Curing. Concrete shall be cured for at least 72 hours. Curing shall be by means of moist burlap mats or by other approved methods as set forth in **Subsection 601.03.8; Curing**, of these Specifications. During the curing period all traffic, both pedestrian and vehicular, shall be excluded. Vehicular traffic shall be excluded for such additional time as the Engineer may direct.

h. Cutting and Matching Existing Concrete Sidewalks or Driveways. Where a newly constructed sidewalk and/or driveway abuts an existing sidewalk or driveway, the existing sidewalk or driveway shall be cut with a concrete saw only. The concrete saw shall conform to **Subsection 501.03.2; Para. c** of these Specifications.

905.03.4 Bituminous Sidewalks and Driveways.

a. Excavation and Forms. Excavation and forms shall meet the requirements of **Subsections 905.03.3; Paras. a and c**, respectively. The limits of excavation will be as shown on the Plans, or as directed by the Engineer. All material within the limits of excavation must be removed and replaced with gravel borrow subbase.

b. Gravel Borrow Subbase. Gravel material shall be placed in layers not exceeding 6 inches in depth and each layer shall be compacted as specified in **Subsection 301.03.2** of these Specifications.

c. Placing Bituminous Sidewalk and Driveway Material. Bituminous sidewalk and driveway material shall be placed on the compacted base in one or more courses as indicated to give the required depth when rolled. Compaction shall be accomplished by means of a power roller of a type and weight acceptable to the Engineer. In areas inaccessible to the roller, hand tamping or hand roller will be permitted. In any case, the bituminous material shall be uniformly compacted.

The Contractor shall simultaneously extend the binder and Type I-1 surface course from the project roadway into all driveways which are not constructed with Portland cement concrete for a length of 3 feet, thereby eliminating cold joints at the gutter line.

905.04 METHOD OF MEASUREMENT.

905.04.1 Portland Cement Sidewalks and Driveways. "Portland Cement Concrete Sidewalks and Driveways" will be measured by the number of cubic yards of pavement actually placed in accordance with the Plans and/or as directed by the Engineer.

905.04.2 Bituminous Concrete Sidewalks and Driveways. "Bituminous Concrete Sidewalks and Driveways" will be measured by the number of tons of pavement material actually placed in accordance with the Plans and/or as directed by the Engineer.

905.05 BASIS OF PAYMENT.

905.05.1 Portland Cement Concrete Sidewalks and Driveways. The accepted quantities of "Portland Cement Concrete Sidewalks and Driveways" will be paid for at the contract unit price per cubic yard as listed in the Proposal. A maximum 5 percent overrun of the calculated quantities based on the required thickness as shown on the Plans is permissible. The price so-stated constitutes full and complete compensation for all labor, materials and equipment, including expansion joint material, reinforcement, and all other incidentals required to finish the work, complete and accepted by the Engineer.

Excavation and gravel borrow subbase will be paid for separately under appropriate work items.

905.05.2 Bituminous Concrete Sidewalks and Driveways. The accepted quantities of "Bituminous Concrete Sidewalks and Driveways" 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 other incidentals required to finish the work, complete and accepted by the Engineer.

Excavation and gravel borrow subbase will be paid for separately under appropriate work items.

SECTION 906

CURBING FOR ROADWAYS

906.01 DESCRIPTION. This work consists of the construction of curbing on prepared gravel bases and/or the construction of bituminous berm on underlying pavement courses at the locations indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

906.01.1 Types of Curbing. The following types of curbing are designated as follows:

a. Granite Curbing.

b. Precast Concrete Curbing.

c. Bituminous Curbing.

d. Bituminous Berm.

e. Remove Handle, Haul, Trim and Reset Curbing and Edging, Straight and/or Circular. All Types.

906.02 MATERIALS.

906.02.1 Granite Curbing. Granite curbing shall conform to the requirements of **Subsections M.09.01 and M.09.02; Granite Curb for Roadways and Granite Slope Curbing for Roadways**, respectively, of these Specifications.

906.02.2 Precast Concrete Curbing. Concrete for curbing shall be Class Z(AE) and shall conform to the applicable requirements of **SECTION 601; PORTLAND CEMENT CONCRETE**, of these Specifications with the following exceptions.

a. Job Mix Formula. The Contractor shall submit for approval a job-mix formula for the concrete mix design in accordance with the provisions of **Subsection 601.03.1; Proportioning**, of these Specifications.

b. Tolerances. Precast concrete curbing, apron stones, inlets and related concrete curb products shall conform to the dimensions shown on the Plans. Said dimensions shall fall within the following tolerances:

Dimension	Tolerance ±
Greater than 0" to 12"	1/4"
Greater than 12" to 24"	½"
Greater than 24" to 72"	3/4"

Details and dimensions shall be true and square. The tolerance allowance on each precast element shall not relieve the Contractor from obtaining a suitable configuration of the various installed products.

906.02.3 Bituminous Curbing. Bituminous material for curbing shall conform to the requirements of **Subsection M.09.04** of these Specifications.

906.02.4 Bituminous Berm. Bituminous material for berm shall conform to the requirements for Class I-1 Surface Course as set forth in **Subsection M.03.01** of these Specifications. Tack coat shall conform to the requirements for emulsified asphalt as set forth in **Subsection M.03.03.4** of these Specifications. Highway joint sealant material shall be as listed in the Department's Approved Materials List.

906.02.5 Gravel Borrow shall conform to the requirements of **Subsection M.01.02** of these Specifications.

906.03 CONSTRUCTION METHODS.

906.03.1 Granite Curbing.

a. Excavation. Excavation shall be made to a sufficient depth to allow for a gravel base course. All soft and unsuitable material shall be removed and replaced with approved granular material which shall be thoroughly compacted.

b. Installation. The curb shall be set such that the front top arris line conforms to the required line and grade. The gravel base upon which the curb is to be set shall be compacted to a firm, even surface.

c. Joints. Curbing stones shall be placed end-to-end as close as possible. No more than ½-inch opening shall show for the full width of the top and 8 inches down from the front.

d. Backfilling. After the curb has been set, any remaining excavated areas shall be backfilled with approved material and thoroughly compacted back and front to grade.

906.03.2 Precast Concrete Curbing. The installation of precast concrete curbing shall conform to the requirements of **Subsection 906.03.1**, above.

906.03.3 Bituminous Curbing.

a. Excavation. Excavation shall conform to the requirements of **Subsection 906.03.1; Para. a**, above.

b. Preparation of Bed. When curbing is to be constructed on a fresh laid bituminous surface, that surface must first be cleaned.

c. Installation. Bituminous curbing shall be constructed by use of a self-propelled automatic curber or curb machine, or a paver equipped with curbing attachments.

The automatic curber or curb machine shall be approved by the Engineer prior to its use. The machine shall conform to the following requirements:

1. The weight of the machine shall be such that required compaction is obtained without the machine riding above the bed on which curbing is constructed.

2. The machine shall form curbing that is uniform in texture, shape and density.

3. The Engineer may permit the construction of curbing by means other than the automatic curber when either short sections, or sections with short radii, are required or for other reasons as may be warranted. The curbing produced by such alternate means shall conform in all respects to the curbing produced by the use of the machine.

d. Painting and Sealing. Painting and/or sealing shall be applied only on curbing which is clean and dry and which has reached the ambient temperature.

906.03.4 Bituminous Berm. The bituminous berm shall be placed on the underlying pavement course in accordance with either Method A or B as described below.

Method A. The berm is placed at the same time as the asphalt surface course in one operation.

The underlying pavement shall be broom cleaned and tacked prior to placement. The bituminous berm will be placed in one lift and will be compacted by a smooth steel wheel roller of a type and weight acceptable to the Engineer.

Method B. The berm is placed independent of the asphalt surface course placement.

The berm shall be founded entirely on the base course. Any adjacent binder course and surface course shall be saw cut as required to form a true and even edge. The portion of the base course on which the berm is to be placed as well as any vertical saw cut edge shall be cleaned to the satisfaction of the Engineer and covered with an approved bituminous tack coat. The berm shall be placed in one layer and shall be compacted by a smooth steel wheel roller of a type and weight acceptable to the Engineer. After the berm is placed, the joint between the berm and the existing pavement shall be sealed with an approved highway joint sealant.

906.03.5 Remove, Handle, Haul, Trim, and Reset Curbing and Edging, Straight and/or Circular, All Types. The existing curbing or edging shall be carefully removed to minimize damage to said units and adjacent pavement or sidewalks. The curbing or edging will then be handled, hauled and stockpiled as required. The ends for jointing will be cut and squared. All curb or edging must be thoroughly cleaned prior to resetting.

If the curb or edging is to be reset in either its original or new location, excavation shall be made to the dimensions shown on the Plans or as directed by the Engineer to allow for the proper fine grading and compaction of the gravel borrow subbase. All soft or unsuitable materials shall be removed and replaced with gravel borrow material which shall be thoroughly compacted to prevent future settlement of the reset curb or edging.

The curb or edging shall be reset such that the front top arris line conforms to the required line and grade. The gravel base upon which the curb or edging is to be reset shall be placed in layers not exceeding 6 inches in depth. Each such layer shall then be compacted to 95 percent of maximum density by means of a vibratory compactor of a size and type approved by the Engineer.

Curbing and edging shall be laid with joints as narrow as possible for stone curb. The individual stones shall be trimmed and cut as necessary so that no more than ½-inch opening shall show for the full width of the top and 8 inches down from the front.

After the curbing or edging has been reset, any remaining excavation areas shall be backfilled with approved granular material and thoroughly compacted back and front to grade. Methods of compaction shall preserve the line and grade of the reset curbing or edging.

The Contractor shall replace with new material any existing curbing or edging that is to be reset which is lost, damaged, or destroyed as a result of either its construction operations or failure to properly store and protect said units, all at no additional cost to the State.

906.04 METHOD OF MEASUREMENT.

906.04.1 Granite Curbing. "Granite Curb-Straight" and "Granite Curb-Circular" will be measured (along the front face of the section at the finished grade elevation) by the number of

linear feet of such curbing actually installed in accordance with the Plans and/or as directed by the Engineer.

"Granite Curb Corners," "Granite Curb Transitions," "Granite Curb Apron Stones," "Granite Curb Inlet Stones" and "Granite Curb Wheelchair Ramp Transitions and Curb" will be measured by the number of each such units actually installed in accordance with the Plans and/or as directed by the Engineer.

906.04.2 Precast Concrete Curbing. "Precast Concrete Curb-Straight" and "Precast Concrete Curb-Circular" will be measured (along the front face of the section at the finished grade elevation) by the number of linear feet of such curbing actually installed in accordance with the Plans and/or as directed by the Engineer.

"Precast Concrete Curb Corners," and "Precast Concrete Curb Transitions," "Precast Concrete Curb Apron Stones," "Precast Concrete Curb Inlet Stones" and "Precast Concrete Curb Wheelchair Ramp Transitions and Curb," will be measured by the number of each such units actually installed in accordance with the Plans and/or as directed by the Engineer.

906.04.3 Bituminous Curbing. "Bituminous Curbing" will be measured (along the front face of the section at the finished grade elevation) by the number of linear feet of such curbing actually installed in accordance with the Plans and/or as directed by the Engineer. Deduction in length will be made for the presence of drainage structures installed along the curbline such as catch basins, drop inlets, etc.

906.04.4 Bituminous Berm. "Bituminous Berm" will be measured by the number of linear feet actually installed in accordance with the Plans and/or as directed by the Engineer.

906.04.5 Remove, Handle, Haul, Trim, and Reset Curbing and Edging, Straight and/or Circular, All Types. "Remove, Handle, Haul, Trim and Reset Curbing and Edging, Straight and/or Circular, All Types" will be measured (along the front face of the section at the finished grade elevation) by the number of linear feet of such curbing reset in accordance with the Plans and/or as directed by the Engineer.

"Curb Corners," "Curb Transitions," "Apron Stones," "Inlet Stones," and "Curb Wheelchair Ramp Transitions and Curb" will be similarly measured. Deductions in length will be made for the presence of new drainage structures installed along the curbline such as catch basins, drop inlets, etc.

906.05 BASIS OF PAYMENT.

906.05.1 Granite Curbing. The accepted quantities of "Granite Curb-Straight" and "Granite Curb-Circular" will be paid for at their respective contract unit prices per linear foot as listed in the Proposal.

The accepted quantities of "Granite Curb Corners," "Granite Curb Transitions," "Granite Curb Apron Stones." "Granite Curb Inlet Stones," and "Granite Curb Wheelchair Ramp Transitions and Curb" will be paid for at their respective contract unit prices per each as listed in the Proposal.

906.05.2 Precast Concrete Curbing. The accepted quantities of "Precast Concrete Curb-Straight" and "Precast Concrete Curb-Circular" will be paid for at their respective contract unit prices per linear foot as listed in the Proposal.

The accepted quantities of "Precast Concrete Curb Corners," "Precast Concrete Curb Transitions," "Precast Concrete Curb Apron Stones," "Precast Concrete Curb Inlet Stones," and "Precast Concrete Curb Wheelchair Ramp Transitions and Curb" will be paid for at their respective contract unit prices per each as listed in the Proposal.

906.05.3 Bituminous Curbing. The accepted quantity of "Bituminous Curbing" will be paid for at the contract unit price per linear foot as listed in the Proposal.

The prices stated above for Granite Curbing, Precast Concrete Curbing, and Bituminous Curbing constitute full and complete compensation for all labor, materials and equipment, including excavation, joints, gravel borrow, backfilling, and all other incidentals required to finish the work, complete and accepted by the Engineer.

The following work will be paid for separately under appropriate work items: saw cutting, the removal and disposal of existing pavements, both rigid and flexible, and sidewalks.

906.05.4 Bituminous Berm. The accepted quantity of "Bituminous Berm" will be paid for at the contract unit price per linear foot as listed in the Proposal. However, the quantity of bituminous material used in the berm is not included in this contract unit price, but rather is included in the unit price listed for Class I-1, Bituminous Concrete Pavement. The unit price for Bituminous Berm includes all preparatory items required for proper placement of the berm, including bituminous tack coat; placement and compaction of the berm; sealing of the joints; and all other incidentals necessary to finish the work, complete and accepted by the Engineer.

906.05.5 Remove, Handle, Haul, Trim and Reset Curbing and Edging, Straight and/or Circular, All Types. The accepted quantities of "Remove, Handle, Haul, Trim and Reset Curbing and Edging, Straight and/or Circular, All Types," for each kind and type specified, will be paid for at the respective contract unit prices per linear foot as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, materials, and equipment, including removal and disposal of existing pavement structure, excavation for removal and setting unless otherwise noted that resetting excavation is to be paid for separately, all handling, hauling and stockpiling, cleaning all sections to be reset, cutting and trimming as necessary to provide the maximum ½-inch opening across the top and down the front of the curbing, gravel borrow subbase course including compaction and fine grading unless otherwise noted, the resetting of the curb or edging to line and grade, backfilling, compacting, and all other incidentals required to finish the work, complete in place and accepted by the Engineer.

Saw cutting, replacement concrete base, and any concrete required between the reset curb or edging and the existing pavement structure will be paid for separately under appropriate work items.

SECTION 907

DUST CONTROL

907.01 DESCRIPTION. This work consists of furnishing and applying water and/or calcium chloride to reduce dust nuisance and hazard within the project limits as directed by the Engineer, all in accordance with these Specifications.

907.02 MATERIALS.

907.02.1 General. Water used for dust control shall be fresh and free from injurious amounts of oil, acid, salt, alkali, organic matter, or other deleterious substances.

907.02.2 Calcium Chloride. Calcium chloride used for dust control shall conform to the requirements of **Subsection M.10.02** of these Specifications.

907.03 CONSTRUCTION METHODS.

907.03.1 Water. The Contractor will be required to sprinkle with water such sections of the subgrade and slopes as the Engineer may designate. An average application of one gallon of water per square yard of exposed area should be considered for each treatment. The exact number of applications and amount of water used shall be based upon field and weather conditions. The application and amount of water shall be as directed by the Engineer.

Prior to actual use the sprinkling equipment shall be equipped with adequate shut-off control and shall be approved by the Engineer. Sprinkling equipment suitable for horizontal and embankment areas shall be kept available at all times for this specific work. The Contractor shall be prepared to perform the work at any time, including Sundays and holidays. The work shall be done upon order of the Engineer.

The Contractor shall make provisions and arrange with a public water supply for a separate meter, specifically for this item. Under no conditions is the use of water necessary to obtain proper compaction of embankments, base course or the proper curing of any surface course or structure to be furnished from this source.

The Contractor shall make provisions and arrange with a public water supply for a separate meter for water used on other items of construction.

Where a public water supply is not available as a source of water supply, the Contractor shall furnish the required amounts from the nearest possible location available.

907.03.2 Calcium Chloride. Calcium chloride shall be applied only at the locations, at such times, and in the amount as may be directed by the Engineer. An average application of one pound of calcium chloride per square yard of exposed area should be considered for each treatment. The exact number of applications and amount of calcium chloride shall be based upon field and weather conditions. It shall be spread in such manner and by such devices that uniform distribution is attained over the entire area on which it is placed.

907.04 METHOD OF MEASUREMENT.

907.04.1 Water. "Water for Dust Control" will be measured by the number of thousand gallons actually applied as directed by the Engineer. The Contractor shall provide an acceptable method for measuring the quantity of water applied to highways and embankments from sources other than a metered public water supply.

907.04.2 Calcium Chloride. "Calcium Chloride for Dust Control" will be measured by the number of tons actually applied as directed by the Engineer. The Engineer may allow the weights as printed on the shipping containers to constitute the official measure. Otherwise, the Contractor shall provide scales to weight the material at no additional cost to the State.

907.05 BASIS OF PAYMENT.

907.05.1 Water. The accepted quantities of "Water for Dust Control" will be paid for at the contract unit price per 1,000 gallons as listed in the Proposal. The price so-stated is full and complete compensation for all labor, materials, and equipment, all other incidentals required to finish the work, complete and accepted by the Engineer.

907.05.2 Calcium Chloride. The accepted quantities of "Calcium Chloride for Dust Control" 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 other incidentals required to finish the work, complete and accepted by the Engineer.

907.05.3 Failure to Comply. If, in the judgement of the Engineer, the Contractor fails to adequately control dust in accordance with this Specification, or as directed, the daily charge set forth in **Special Provision Code 907.1000** will be deducted from monies then due the Contractor as a charge for failure to comply with this Specification. Moreover, the stated daily charge will continue each consecutive calendar day thereafter until dust is adequately controlled.

In addition, if the Department's Maintenance Division is required to perform dust control operations due to the failure of the Contractor to provide same, all costs associated with these operations of the Maintenance Division will likewise be deducted from monies then due the Contractor.

SECTION 908

FLAGSTONES

908.01 DESCRIPTION. This work consists of providing flagstone walks and treads of the type and at the locations indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

908.02 MATERIALS. Flagstone shall conform to the requirements of **Subsection M.10.06; Flagstones,** of these Specifications.

Sand shall conform to the requirements of **Section M.02.02.1; Fine Aggregate for Mortar,** of these Specifications.

Mortar shall conform to the requirements of **Section M.04.03.5; Mortar**, of these Specifications.

908.03 CONSTRUCTION METHODS.

908.03.1 Walks. Flagstone shall be laid on a sand base to the depth indicated on the Plans or as directed by the Engineer. Flagstone shall be laid to the line, grade and design indicated on the Plans or as directed by the Engineer.

908.03.2 Treads. Flagstone treads shall be bedded in mortar and shall be laid to the line, grade, and design indicated on the Plans or as directed by the Engineer.

908.04 METHOD OF MEASUREMENT. "Flagstones" will be measured by the number of square feet of walks or treads actually installed in accordance with the Plans and/or as directed by the Engineer.

908.05 BASIS OF PAYMENT. The accepted quantity of "Flagstones" will be paid for at the contract unit price per square foot as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, and equipment, including sand base and all other incidentals required to finish the work, complete in place and accepted by the Engineer.

SECTION 909

PRECAST CONCRETE MEDIAN BARRIER

909.01 DESCRIPTION. This work consists of providing various types of precast concrete median barriers on previously prepared gravel borrow subbase courses at the locations indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

909.02 MATERIALS.

909.02.1 General.

a. Portland Cement Concrete. Concrete shall be Class XX(AE) and shall conform to the applicable requirements of both **SECTIONS 601 and M.02; PORTLAND CEMENT CONCRETE**, of these Specifications.

b. Reinforcement. Bar reinforcement shall conform to **Subsection M.05.01; Bar Reinforcement**, of these Specifications.

Dowels shall conform to the requirements of ASTM A36 and be either epoxy coated or galvanized in accordance with **Subsections M.05.05 and M.05.06**, respectively, of these Specifications.

c. Anchor Bolts for Light Standards. Bolts and nuts shall conform to **Subsection M.05.04.4, Para. a** of these Specifications. The top exposed 4 inches of anchor bolts, together with their nuts, shall be galvanized in accordance with **Subsection M.05.06**, of these Specifications.

909.03 CONSTRUCTION METHODS.

909.03.1 Plant Requirements.

a. Manufacture. Precast concrete barrier units shall be manufactured in accordance with the applicable provisions of **SECTION 601 and SECTION 809; PORTLAND CEMENT CONCRETE** and **PRECAST/PRESTRESSED STRUCTURE CONCRETE MASONRY**, respectively, of these Specifications.

b. Reinforcement. All reinforcing bars shall have a minimum cover of 2 inches.

c. Dowels, Light Standard Bolts. Dowels shall be accurately set and maintained at right angles to the plane of the end of the unit. Anchor bolts for light supports shall be accurately spaced in the required bolt circle and maintained vertical to the plane of the bottom of the recess.

d. Casting. The units shall be cast with the forms in a 180-degree inverted position.

Devices cast flush with the bottom of the barrier to facilitate removal from the forms may be left in place with approval of the Engineer. Such lifting devices shall be located so that the unit will not be over-stressed while lifting in the inverted position. The finish on all exposed surfaces shall be smooth and dense concrete with a reasonably uniform appearance. No rub will be required, but any air holes shall be immediately filled and finished after form removal to the satisfaction of the Engineer.

Units shall not be removed from forms before attaining the minimum 7-day compressive strength.

e. Inspection. All precast concrete barrier units shall be inspected both at the points of manufacture and on the project site. Any units showing defects or damage shall be removed and replaced by the Contractor at no additional cost to the State.

f. Tolerances. Precast concrete median barrier units shall be cast true and square in accordance with the applicable details as shown on the Plans. Dimensions of units shall be accurate within the following tolerances:

Dimension	Tolerance ±
Greater than 0" to 12"	1/4"
Greater than 12" to 24"	½"
Greater than 24" to 72"	3/4"
Greater than 6' to 20'	1"

909.03.2 Preparation of Subbase. The subbase shall be furnished and placed in accordance with **Subsections 302.03.1 and 302.03.2; Placing** and **Shaping and Compaction**, respectively, of these Specifications.

909.03.3 Setting. Units shall be placed on previously prepared gravel borrow subbase to the lines and grades shown on the Plans. Precast concrete blocks, previously set in the compacted subbase and flush with the finish grade, shall be used.

When single-faced barrier units are installed on horizontal curves and/or at locations where they are back to back because of a grade difference between roadways, the Contractor will be allowed to use 2-inch by 4-inch timbers as spacers to facilitate the installation of the units. The space between the units is to be filled with a cement concrete grout mixture approved by the Engineer.

Care shall be exercised during hauling, storage, hoisting and handling of the units to prevent cracking or damage. No damaged units shall be installed. Units showing defects or damage shall be removed and replaced or repaired by the Contractor at no additional cost to the State.

909.04 METHOD OF MEASUREMENT. "Precast Concrete Median Barrier" units of the various types and configurations specified on the Plans will be measured in linear feet of continuous runs of said units actually installed in accordance with the Plans and/or as directed by the Engineer.

"Standard Precast Concrete Median Barrier Light Units" and "Transition Units" will be measured by the number of such units actually installed in accordance with the Plans and/or as directed by the Engineer.

909.05 BASIS OF PAYMENT. The accepted quantities of "Precast Concrete Median Barrier" of the various types and configurations specified on the Plans will be paid for at their respective contract unit prices per linear foot as listed in the Proposal. The accepted quantities of "Standard Precast Concrete Median Barrier Light Units" and "Transition Units" will be paid for at their respective contract unit prices per each as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, materials, and equipment for furnishing and placing units on previously prepared compacted subbase courses, including spacer timbers and concrete grout where applicable, and for all other incidentals required to finish the work, complete, in place and accepted by the Engineer.

Payment for compacted gravel borrow subbase course is not included in the contract unit prices for precast concrete median barrier units.

SECTION 910

RAISED REFLECTIVE PAVEMENT MARKER (SNOW PLOWABLE)

910.01 DESCRIPTION. This work consists of providing snow plowable raised reflective pavement markers (RRPM), yellow, and white, at locations designated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

910.02 MATERIALS.

910.02.1 The Unit. The marker shall be Stimsonite Model 96LP as manufactured by Amerace Corporation, Signal Division, or approved equal. The marker shall consist of an iron casting to which is attached a replaceable prismatic reflective element. The pavement reflector and casting shall be able to withstand snow plowing in opposite directions without sustaining damage.

a. Casting. The casting shall be manufactured of nodular iron conforming to ASTM A536, hardened to 52-54 RC and shall be marked with the manufacturer's name and model number.

The dimensions of the casting shall be approximately 9.3 inches long by 5.9 inches wide by 1.7 inches high. Installed height shall be approximately 0.25 inches above the road surface. Its weight shall be approximately 5.4 pounds. The surface of the keel and web of the casting shall be free of scale, dirt, oil, grease or other contaminant which may reduce the bond of the casting to the epoxy adhesive.

b. Reflectors. The reflector shall consist of an acrylic plastic shell filled with a tightly-adherent potting compound. The shell shall contain one or two prismatic retro reflective faces to reflect incident light from single or opposite directions. The reflector shall be laminated to an elastomeric pad and adhesively attached to the casting. The reflector shall be shaped like the shallow frustum of a pyramid and shall conform to the following design requirements:

Dimensions:	4" x 2" x 0.48" (nominal)
Slope of Reflecting Surface:	30 degrees
Area of Each Reflecting Surface:	1.87 square inches (nominal)
Thickness of Elastomeric Pad:	0.04 inch

The outer surface of the shell shall be smooth except for purposes of identification. Thin untempered glass shall be bonded to the prismatic reflective faces to provide an extremely hard and durable abrasion-resistant surface.

The shell shall be molded of methyl methacrylate conforming to Federal Specification L-P-380C, Type I, Class 3.

The color of the reflective elements when illuminated by an automobile headlight shall be white or amber. Off-color reflection shall constitute grounds for rejection.

The reflectors shall be adhered to the casting, in proper position, at the factory.

910.02.2 Epoxy Adhesive; Marker to Roadway. The formulation of epoxy adhesive shall conform to the requirements of the current issue of AASHTO M237.

The manufacturer of the RRPM's must approve of the use of any particular formulation of epoxy adhesive.

The epoxy manufacturer shall provide the Engineer with a Certificate of Analysis with the delivery of the material. This certificate shall include the formulation of the adhesive as determined by Certified Test Data of the component parts and the cured system. Tests shall be conducted in accordance with methods set forth in AASHTO M237, current issue.

The formulation should be for both components and should indicate all its various parts, their brand names, producers and percent by weight.

Certified test data may be provided by either the epoxy adhesive manufacturer or an independent testing laboratory. Test results for each individual batch must be provided.

The Contractor shall also furnish to the Engineer a 1-pint sample of each component from the initial batch of epoxy adhesive to be used on the project and each subsequent batch.

910.03 CONSTRUCTION METHODS.

910.03.1 Surface Preparation. At the time of installation, the metal casting shall be free of dirt, oil, grease, rust, moisture or any foreign matter which will impair adhesion to the pavement. It shall be the Contractor's responsibility to clean each contaminated casting by sand blasting or some other approved method to remove all such foreign matter prior to installation.

Pavement markers shall not be placed on pavement surfaces that show evidence of cracking, checking, spalling or failure of underlying base material.

If during the laying out process, it is determined that the marker would be installed at a point with one of the aforementioned surface defects or at a pavement construction joint, then the marker shall be relocated a distance not to exceed 10 percent of the typical marker spacing.

The minimum pavement surface temperature at the time of application shall be that recommended by the epoxy manufacturer. No markers shall be installed if the pavement surface or precut slots are wet.

910.03.2 Installation. Plowable pavement markers shall be installed by inserting the two keels of the casting into parallel slots cut into the pavement, said slots to be partially filled with epoxy

adhesive, all in accordance with the RRPM manufacturer's recommendations. The markers shall be placed no later than seven days after the slots are cut into pavement.

Before applying the epoxy adhesive, the slots shall be brushed or blown clean of loose material and shall be dry. A pre-determined amount of epoxy shall be placed in and between the slots to insure that all voids beneath and around the casting are filled so as to create a watertight seal around the casting, and yet not produce an excessive overflow resulting in unacceptable residue on pavement. The keels of the pavement marker casting shall be hand placed into the slots in such a manner as to assure that the tips of the marker's deflecting surface are below the pavement surface. The four lugs on the keels of the casting shall be in contact with the pavement.

The epoxy adhesive requires that the mixing operation and placing of the pavement markers be accomplished in a timely manner. Any mixed batch that becomes so viscous that it cannot be readily extruded from under the marker under light pressure shall not be used. Any heating of the epoxy shall be by the application of indirect heat.

The markers shall be protected against traffic until the adhesive has hardened. The following table may be used as a guideline.

Ambient Air Temperature °F	**Minimum Period Protected From Traffic (Minutes)**
100	15
90	20
80	25
70	30
60	35
50[1]	45

Note 1: No installations will be made at a lower temperature than 50°F unless the epoxy manufacturer can guarantee his product will harden sufficiently at this lower temperature to withstand traffic in 45 minutes.

Excess adhesive on the pavement and on the exposed surface of the marker shall be immediately removed.

Any marker leaving a raised end exposed above the pavement must be removed. The resulting hole must be filled with an acceptable patch and a new marker properly installed within 2 feet from the faulty installation.

910.04 METHOD OF MEASUREMENT. "Raised Reflectorized Pavement Markers (Snow Plowable)" will be measured by the number of such units actually furnished and installed in accordance with the Plans and/or as directed by the Engineer.

910.05 BASIS OF PAYMENT. The accepted quantity of "Raised Reflectorized Pavement Markers (Snow Plowable)" will be paid for at the contract unit price per each as listed in the Proposal. The price so-stated is full and complete compensation for all labor, materials and

equipment, including cutting the pavement to the specified dimensions to receive the marker housing, mixing the epoxy adhesive and placing it into the parallel slots, placing the marker units in the prepared slots, and all other incidentals required to finish the work, complete in place and accepted by the Engineer.

SECTION 911

STONE MASONRY WALLS

911.01 DESCRIPTION. This work consists of providing wet stone masonry walls of standard designs at locations indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

911.02 MATERIALS.

911.02.1 General.

a. Stone. Stone for masonry walls shall conform to the requirements of **SECTION M.14; STONE FOR MASONRY**, of these Specifications.

b. Mortar. Mortar shall conform to the requirements **Subsection M.04.03.5; Mortar**, of these Specifications.

911.03 CONSTRUCTION METHODS.

911.03.1 Weather Limitations. Temperature and weather conditions for stone masonry wall construction shall conform to the provisions of **Subsection 807.03.1** of these Specifications.

911.03.2 Mixing of Mortar. The requirements for the mixing of mortar shall conform to the provisions of **Subsection 807.03.2** of these Specifications.

911.03.3 Selecting and Storing Stone. A sufficient stock of the approved stone shall be kept on the site to permit adequate selection and blending of stones by the masons. The stones shall be kept free from dirt, oil, or any other injurious material which may prevent the proper adhesion of the mortar or detract from the appearance of the exposed surfaces.

911.03.4 Shaping and Dressing Stones. Selected stone, roughly squared and pitched to line, shall be used at all angles and wall ends. All shaping and dressing of stone shall be performed before the stone is laid in the wall and no dressing or hammering which will loosen the stone will be permitted after it is placed. If a stone is loosened after the mortar is set, it shall be removed, the mortar cleaned off, and the stone re-laid in fresh mortar.

911.03.5 Laying Stone. The wall shall be compactly laid having all vertical joints in the interior of the wall completely filled with suitable stones or spalls thoroughly bedded in mortar. Each stone to be set in mortar shall be cleaned and thoroughly wetted before being set in a full bed of fresh mortar. The stones shall be carefully settled in place before the mortar has set. Any mortar

in which initial set has commenced shall be removed from the mixing boards or receptacles and not used in the work. No retempering of mortar will be allowed. When laying is interrupted, the top courses shall be left unplastered.

Masonry shall be laid to line and in the pattern required. The stone shall be laid with bearing beds parallel to the natural bed of the material. The use of chinking stones in the face must be kept to a minimum and will be permitted only in the horizontal joints to provide firm bearing of stones. Chinking of vertical joints in the face will not be permitted. Care shall be taken to prevent the bunching of small stones or stones of similar size. When weathered or colored stones, or stones of varying textures are being used, care must be exercised to distribute the various kinds of stones uniformly throughout the exposed faces of the work. The foundation (base) of the wall shall be composed of large stones (stones that are distinctly larger than the majority of the stones in the wall) that are laid to form a relatively flat surface upon which the succeeding courses may be placed. Large stones shall be used for the bottom courses and, in general, shall decrease in size from the bottom to the top of the work.

At least one-fourth of the stones in the face shall be headers (a stone laid with its end toward the face of the wall) and these shall be evenly distributed. Headers shall extend not less than 12 inches into the core (or the stones that make up the center) of the wall. Headers must be uniform in height and width throughout their length. Headers in walls 2 feet or less in thickness shall extend entirely through the wall.

All stones shall be laid to break joints and to thoroughly bond the work. Stones are to be placed to form bonds with the stones of adjoining courses of not less than 12 inches in ashlar (squared and dressed stone) and split face masonry and 6 inches in rubble masonry. Headers shall be placed over stretchers (stones laid with their length parallel to the face of the wall) and, in general, the headers of each course shall equally divide the spaces between the headers of adjoining courses. No header shall be placed over a joint and no joint shall be made over a header. Headers shall be placed in each course and must have a width of not less than 1½ times their thickness and must be spaced no further than 8 feet apart, center to center. Stretchers shall have a length of bed not less than 2 nor more than 3½ times their thickness, and not less than 3 feet.

The tops of walls are to be finished flat. Capstones, if required, are to be flat on the upward side and shall not be less than 6 inches in thickness for ashlar and split face masonry and 3 inches in thickness for rubble masonry. At least one-fourth of the stones used on the top of the wall shall be tie stones and shall extend entirely across the top. The remaining stones used in constructing the top course must be of a size that allows the top course to be constructed by the placement of no more than two stones across the width of the wall, and are to be no less than 8 inches in width.

911.03.4 Joints. Joints requiring pointing shall be finished such that the mortared joint is filled to the face line of the wall unless otherwise noted on the Plans. The mortar is to be finished such that it is pitched downward and away from the center of the wall. Joints on the top of the wall are to be pointed flush with the top of the wall and are to be slightly pitched to direct water off of the wall. Whenever possible, joints are to be properly pointed before the mortar becomes set. Joints which cannot be so pointed shall be prepared for subsequent pointing by raking the mortar out to a depth of 2 inches before the mortar has set. Joints not pointed at the time the stones are laid shall be thoroughly wet with clean water and filled with mortar. The mortar shall be well driven into the joints and finished with a pointing tool which is approved by the Engineer.

The maximum widths of joints in the faces and tops of stone masonry walls will be as follows:

	Ashlar	Split Face	Rubble
Face	½"	1"	1"
Top	½"	3/4"	1"

911.03.5 Weep Holes. The Contractor shall furnish and install drainage holes and weep holes as detailed and at the locations indicated on the Plans or as designated by the Engineer.

911.03.6 Excavation. Excavation below the designated slope or subgrade, and subsequent backfilling, shall be carried out in accordance with the applicable requirements of **SECTION 203; STRUCTURE EXCAVATION AND BACKFILL**, of these Specifications.

911.03.7 Backfilling. The backfilling shall be accomplished with approved pervious materials placed in layers of not more than 6 inches in thickness. Each layer shall be thoroughly compacted before the succeeding one is placed.

911.03.8 Cleaning. After the mortar has set, the wall shall be thoroughly cleaned and left in a neat and workmanlike condition.

911.04 METHOD OF MEASUREMENT. "Stone Masonry Walls" will be measured by the number of cubic yards of masonry actually installed in accordance with the Plans and/or as directed by the Engineer.

911.05 BASIS OF PAYMENT. The accepted quantity of "Stone Masonry Walls" will be paid for at the contract unit price per cubic yard as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, and equipment, including mortar, stone masonry, weep holes, backfilling, protection during curing, and for all other incidentals required to finish the work, complete in place and accepted by the Engineer.

Excavation below the designated slope or subgrade line will be paid for in accordance with the applicable requirements of **SECTION 203; STRUCTURE EXCAVATION AND BACKFILL**, of these Specifications.

SECTION 912

REMOVE AND REBUILD OR CONSTRUCT NEW DRY-LAID STONE WALLS

912.01 DESCRIPTION. This work consists of the removal and resetting of existing sections or the construction of new sections of dry-laid stone walls at locations indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications. Walls will be considered "double faced" unless otherwise noted on the Plans.

912.02 MATERIALS. Stones used to construct new walls shall conform to **SECTION M.14; STONE FOR MASONRY**, of these Specifications unless otherwise directed by the Engineer. Stones to be used in walls designated to be removed and reset shall consist of the stones in the present wall and any additional stones required to complete the work. Additional stones necessary to complete the wall sections shall conform to existing stones relative to shape, texture, color and geological composition. In the case of existing walls comprised predominantly of flat stones, any additional stones required shall not be less than 3 inches thick, 10 inches wide and 12 inches long in size. For walls comprised mostly of round stones, any additional stones required shall be not less than 9 inches thick, 12 inches wide and 12 inches long in size. Stones that are smaller than these dimensions may be used only for pinning and/or filling interstices within the wall.

912.03 CONSTRUCTION METHODS.

912.03.1 Trenching. Trenches for constructing stone walls shall be excavated to a depth of 12 inches and to a width of 36 inches unless other dimensions are indicated on the Plans or provided by the Engineer.

912.03.2 Laying Stone. The stones shall be laid to line and in courses roughly leveled up. The bottom, or foundation, courses shall be composed of large stones and are to be laid to form a relatively flat surface upon which the succeeding courses may be placed. The open spaces about the foundation (or base) of the wall shall be filled in with suitable material excavated from the trench. All stones shall be laid with bearing beds parallel to the natural bed of the material. Select stones, roughly squared, are to be used at the ends and at angles in the wall. The foundation courses shall consist of the large stones and the thinnest courses shall be placed towards the top of the wall.

The stone wall shall have a width of not less than 24 inches and a height of 3 feet above the surrounding ground surface unless otherwise indicated on the Plans. These dimensions may be increased or decreased where necessary to conform with adjoining walls which are to remain in place, all as directed by the Engineer. If, in order to complete the wall, it becomes necessary to use stones other than those which are present in the existing wall, the additional stones shall be used in the foundation and distributed evenly throughout the wall.

Care must be taken to insure that each stone takes a firm bearing at not less than three separate points upon the underlying course. Open joints shall be chinked and spalls fitted to provide firm bearing throughout the length of the stone. Face joints shall not exceed 1 inch in width unless otherwise directed by the Engineer. Chinking will be permitted only in horizontal joints in the faces. The chinking of vertical joints in the faces of the wall will not be permitted.

Header stones shall hold in the heart of the wall and must extend not less than 12 inches into the core. They shall occupy not less than one-fourth of the face area of the wall and shall be evenly distributed. Header stones in walls, 2 feet or less in thickness, shall extend entirely through the wall.

The top of the wall must be finished flat and shall contain tie stones that extend entirely across the width of the wall. Tie stones shall make up no less than one-fourth of the stones in

the course. All stones used in the top course shall have a width of no less than 8 inches and a thickness of at least 3 inches.

All excess material shall be removed and disposed of and the work area shall be left in a clean and neat condition satisfactory to the Engineer.

912.04 METHOD OF MEASUREMENT. "Remove and Rebuild New Dry-Laid Stone Walls" or "Construct New Dry-Laid Stone Walls" will be measured by the number of linear feet of continuous runs of those constructed or reconstructed walls actually installed in accordance with the Plans and/or as directed by the Engineer.

912.05 BASIS OF PAYMENT. The accepted quantities of "Remove and Rebuild New Dry-Laid Stone Walls" or "Construct New Dry-Laid Stone Walls" will be paid for at their respective contract unit prices per linear foot as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, materials and equipment, and all other incidentals required to finish the work, complete in place and accepted by the Engineer.

Excavation below the designated slope or subgrade line for the installation of dry-laid stone walls will be paid for in accordance with **SECTION 203; STRUCTURE EXCAVATION AND BACKFILL**, of these Specifications.

Stones required for the construction of new walls will be included in the contract price for "Construct New Dry-Laid Stone Walls." Stones provided by the Contractor to supplement quantities of existing stones from existing walls to meet the requirements of this Specification will be paid for separately under proposal item, "Supplementary Stones for Walls."

SECTION 913

TRAFFICPERSONS

913.01 DESCRIPTION. This work consists of providing police officers as deemed necessary by the Engineer for the direction and control of both vehicular traffic and pedestrians within the limits of the project, all in accordance with these Specifications.

913.02 QUALIFICATIONS. Police officers shall wear regulation uniforms and should be regular, reserve, or special officers of the communities in which they serve.

913.03 CONSTRUCTION METHODS. Not applicable.

913.04 METHOD OF MEASUREMENT. Services of "Trafficpersons" will be measured for payment by the number of hours for each person rendering services in accordance with directions of the Engineer. This is to include, however, only such trafficpersons as are employed within either the limits of the construction or the right-of-way for the project, upon detours stipulated in

the Contract; or upon detours ordered by the Engineer. Trafficpersons furnished by the Contractor for continued use of a detour or bypass beyond the period for which the Engineer deems such trafficpersons necessary to the proper completion of the project or at locations where traffic is unnecessarily restricted by the Contractor's method of operation, will not be measured for payment.

913.05 BASIS OF PAYMENT. Although services of Uniformed Trafficpersons (with/without cruisers) will be measured for payment by the number of hours for each person rendering services, there is no bid item for this work.

Uniformed Trafficpersons (with/without cruisers) shall be paid for based on actual cost as submitted by a bill of lading from the local community or communities involved and approved by the Engineer. The payment for this work shall be made directly by the State through a separate Purchase Order submitted by the local community or communities. Payment for the traffic-persons (with/without cruisers) required by the Contractor's operations beyond the period for which the Engineer deems necessary shall be the Contractor's responsibility.

SECTION 914

FLAGPERSONS

914.01 DESCRIPTION. This work consists of providing flagpersons as directed by the Engineer to assist in controlling traffic through the construction site, all in accordance with these Specifications.

914.02 QUALIFICATIONS. Flagpersons must wear protective clothing, be equipped with hand signaling devices for controlling traffic and follow flagging procedures all as described in the latest edition of the Manual on Uniform Traffic Control Devices (MUTCD), with corrections and revisions. Location of flagpersons with respect to the work operation must be approved by the Engineer before work commences.

Flagpersons must be thoroughly familiar with the most recent publication of the "Flagging Handbook," published by the Federal Highway Administration and must possess a certificate of satisfactory completion from a training course approved by the Department. Flagpersons must dress appropriately at all times. Bright orange vests and orange hats will be worn whenever flagpersons are actively engaged in flagging. Any flagpersons determined to be ineffective in controlling traffic by the Engineer may be removed at the discretion of the Engineer.

914.03 CONSTRUCTION METHODS. Not applicable.

914.04 METHOD OF MEASUREMENT. Services of "Flagpersons" will be measured for payment by the number of hours for each person rendering services in accordance with the orders of the Engineer. This is to include, however, only such flagpersons as are employed within the limits of the construction project, upon detours stipulated in the Contract, or upon detours

ordered by the Engineer. Flagpersons furnished by the Contractor for continued use of a detour or by-pass beyond the period for which the Engineer deems such flagpersons necessary for the proper completion of the project or at locations where traffic is unnecessarily restricted by the Contractor's method of operation, will not be measured for payment. The minimum hours of payment for any individual flagperson in any one day shall be the same as for Union Laborers. Overtime hours will be measured separately and paid under the applicable item in the Proposal.

914.05 BASIS OF PAYMENT. The current minimum acceptable bid for regular and overtime hours are provided on Page P-1 of the Proposal.

The unit bid price per manhour as paid to the Contractor shall constitute compensation for the flagpersons' services - including fringe benefits, and for associated protective clothing, hand signaling devices, communications equipment and other applicable equipment and incidentals deemed necessary by the Engineer. Overtime will be compensated for separately and in accordance with the union contract.

The hourly rate of wages paid by the Contractor for flagpersons' services shall not be less than the prevailing rate set by the Rhode Island Department of Labor. There will be no consideration for increasing the unit bid price for Flagpersons during the first eighteen months of the Contract dating from the Contract bid date. If after eighteen months the prevailing rate for Flagpersons is increased due to contractual agreements with the applicable union(s), the Department, upon receipt of proper documentation, will increase the contract unit bid price to the actual rate of pay plus fringe benefits. All subsequent rate increases will also be addressed.

SECTION 915

HIGHWAY BOUNDS

915.01 DESCRIPTION. This work consists of providing granite, reinforced concrete, or bronze highway bounds at points indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

915.02 MATERIALS. Materials shall conform to the requirements of **Subsection M.10.07; Highway Bounds**, of these Specifications. Bronze rods shall be 1¼-inches in diameter and shall be split a distance of 2 inches from the bottom.

915.03 CONSTRUCTION METHODS. Bounds shall be set at the locations shown on the Plans or as directed by the Engineer. When located in lawns, sidewalks or drives, bounds shall be set with the top of the bound ½-inch below the surface. Otherwise, bounds shall be set so as not to project above the surrounding ground by more than 6 inches.

When the bound point falls on ledge and the use of a bronze rod is directed by the Engineer, a 1½-inch hole shall be drilled to a depth of 8 inches and a bronze rod and bronze wedge shall be placed in the drill hole. The rod shall be driven upon the wedge until the rod is solidly wedged into the hole. The rod shall then be firmly embedded either by filling the hole with

a cement grout composed of equal parts of fine sand and cement, or by packing with lead as directed by the Engineer.

915.04 METHOD OF MEASUREMENT. "Highway Bounds" of the various types specified will be measured by the number of such bounds actually furnished and set in accordance with the Plans and/or as directed by the Engineer.

915.05 BASIS OF PAYMENT. The accepted quantities of "Highway Bounds" of the various types specified, will be paid for at their respective contract unit prices per each as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, materials and equipment, and all other incidentals required to finish the work, complete and accepted by the Engineer.

SECTION 916

REMOVE, RELOCATE AND RESET SHOCK ABSORBING BARRIER MODULES

916.01 DESCRIPTION. This work consists of removing sand filled polyethylene modules from their initial locations and subsequently installing said modules at new locations as indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

916.02 MATERIALS. Not applicable.

916.03 CONSTRUCTION METHODS.

916.03.1 Relocation. The Contractor shall assign experienced tradesmen to provide the required technical assistance to personnel removing and relocating the various components of the modules at the site of the work.

916.03.2 Replacement of Damaged Modules. If the shock absorbing barrier modules are damaged by traffic after installation but prior to the completion of the Contract, the Contractor may be required to replace the damaged modules on a "Force Account" basis as set forth in **Subsection 109.04; Para. a.4** of these Specifications.

916.03.3 Maintenance. Maintenance of shock absorbing barrier modules shall be carried out in accordance with **SECTION 937; MAINTENANCE AND MOVEMENT OF TRAFFIC PROTECTIVE DEVICES**, of these Specifications.

916.04 METHOD OF MEASUREMENT. "Removing, Relocating and Resetting Shock Absorbing Barrier Modules" will be measured by the number of "Groups" actually installed. A "Group" is defined as including all modules necessary to complete a specific installation as detailed on the Plans.

916.05 BASIS OF PAYMENT. The accepted quantity of "Removing, Relocating and Resetting Shock Absorbing Barrier Modules" will be paid for at the contract unit price per group as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, including sand and equipment, and all other incidentals required to finish the work, complete and accepted by the Engineer.

SECTION 917

REMOVE AND REPLACE RURAL MAIL BOX POSTS AND MOUNTINGS

917.01 DESCRIPTION. This work consists of removing existing rural mail boxes, posts, and mountings; the setting of the existing boxes in temporary locations, if and as directed; the provision of new posts and the mounting of the existing mail boxes on said new posts at the locations indicated on the Plans and/or as directed by the Engineer, all in accordance with these Specifications.

917.02 MATERIALS. Materials for rural mail box posts, mountings and foundations shall substantially conform to those indicated on the Plans.

917.03 CONSTRUCTION METHODS.

917.03.1 Removing Existing Posts and Boxes. The mail boxes shall be removed together with their posts; the mail boxes shall be carefully detached from the mountings and posts and saved for subsequent remounting on new posts. The post holes shall be filled with suitable materials and properly tamped. The Contractor shall replace, at his own expense, any material damaged or lost due to his methods of removing and dismantling, and the replacement material shall be of the type and kind that was damaged or lost.

917.03.2 Installation.

a. Temporary Locations. If necessary, during the construction period, the mail boxes shall be set in temporary locations as directed, such that they are at all times, insofar as possible, satisfactorily accessible to the mail carrier.

b. Setting Posts. The post holes shall be dug to the depth and in the position shown on the Plans or as indicated by the Engineer. The bottoms of holes shall be thoroughly tamped so that the posts will have a stable foundation. The posts shall be set plumb and true to line and grade and the holes shall be backfilled with approved granular material and thoroughly compacted in layers in such a way as not to displace the posts.

c. Mounting of Mail Boxes. The mail boxes shall be remounted on the new posts as indicated on the Plans. Painting of the posts and top mounts shall be in accordance with the requirements indicated on the Plans.

917.04 METHOD OF MEASUREMENT. "Remove and Replace Rural Mail Box Posts and Mountings" of the various types indicated on the Plans will be measured by the number of such units actually installed in accordance with the Plans and/or as directed by the Engineer.

917.05 BASIS OF PAYMENT. The accepted quantities of "Remove and Replace Rural Mail Box Posts and Mountings" of the various types shown on the Plans will be paid for at the respective contract unit prices per each such unit as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, materials, and equipment, including all excavation, backfilling, disposing of surplus materials, removing and salvaging the existing installations, setting boxes in temporary locations, and for all other incidentals required to finish the work, complete and accepted by the Engineer.

SECTION 918

RURAL MAIL BOXES POSTMASTER APPROVED

918.01 DESCRIPTION. This work consists of replacing existing rural mail boxes with new boxes when said existing boxes do not conform to the specifications of the U.S. Postal Service, 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."

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 other incidentals required to finish the work, complete and accepted by the Engineer.

SECTION 919

TEST PITS

919.01 DESCRIPTION. This work consists of excavating exploratory test pits for the purpose of locating existing utilities of every type, including, but not limited to, water, sewer, storm drains, gas, power distribution and communications, and for determining water table elevations and soil conditions. These excavations shall be performed at locations indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

919.02 MATERIALS. Materials associated with test pit excavations such as backfill, subbase and base courses, bituminous pavements, loam and seeding are specified elsewhere in these Specifications.

919.03 CONSTRUCTION METHODS. Test pit excavations may include any or all of the following items, the construction methods for which are specified elsewhere in these Specifications:

a. Cutting pavement.

b. Breaking up and disposal of existing pavements.

c. Test pit excavation.

d. Backfill and compaction, where required.

e. Loam and seeding.

f. Replacement paving, which shall match as nearly as possible the existing pavement in thickness.

919.04 METHOD OF MEASUREMENT. "Test Pits" shall be measured by the number of individual pits actually excavated, regardless of whether or not utilities were located or water table elevations were determined.

919.05 BASIS OF PAYMENT. The accepted quantity of "Test Pits" will be paid for at the contract unit price per each such excavation as listed in the Proposal. The price so-stated constitutes full and complete compensation for labor, materials, and equipment, including cutting and matching pavement, removal and legal disposal of existing pavements, excavation, pumping and bailing, backfilling, loaming and seeding, where required, and for all other incidentals required to finish the work, complete and accepted by the Engineer.

The replacement of subbase and base courses, and replacement paving and resurfacing will be paid for separately under appropriate work items.

SECTION 920

RIPRAP

920.01 DESCRIPTION. This work consists of providing dumped or placed riprap on prepared surfaces of the sizes and layer thicknesses at the locations indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

920.02 MATERIALS. Materials shall conform to the requirements of **Subsections M.10.03, M.10.03.1 and M.10.03.2; Riprap, Bedding for Riprap, and Stone for Riprap**, respectively, of these Specifications.

Gravel borrow shall conform to the requirements of **Subsection M.01.02; Gravel Borrow**, of these Specifications.

Filter fabric shall be a material suitable for erosion control applications and shall be one of those included on the Department's Approved Materials List.

920.03 CONSTRUCTION METHODS.

920.03.1 General. Slopes to be protected by riprap shall be free of brush, trees, stumps, and other unsuitable material and shall be graded to a smooth surface. All unsuitable material shall be removed to the depth shown on the Plans, or as authorized, and replaced with gravel borrow. Filled areas will be compacted as specified in **Subsections 202.03.3, Para. a and 202.03.3, Para. b**, respectively, of these Specifications. If a toe trench is shown on the Plans, it shall be excavated and maintained until the riprap is placed.

Protection for structure foundations shall be provided as early as the foundation construction permits. The area to be protected shall be cleaned of waste materials and the surfaces to be protected prepared as shown on the Plans. The type of riprap specified will be placed in accordance with these Specifications.

Riprap shall be placed in conjunction with the construction of the embankment. The elapsed time between construction of the embankment and the placement of the riprap shall be limited to that required to permit the orderly construction of the embankment and to preclude the mixing of embankment and riprap materials. The Contractor shall maintain the riprap protection until accepted, and any material displaced by any cause shall be replaced to the lines and grades shown on the Plans at no additional cost to the State.

920.03.2 Filter Fabric. The installation of filter fabric shall strictly conform to the manufacturer's guidelines and as modified herein.

a. The surface of finished ground must be smooth and well compacted. All rock, dirt clods, grass clumps, trash and other obstructions which will prevent the mat from laying in direct contact with the soil surface and which may cause the fabric to puncture or tear must be removed.

b. A minimum overlap width of two feet must be used.

c. Anchor pins must be installed immediately after placement of each section in order to protect from wind uplift.

d. The fabric must be toed-in at the top and toe-in or toe-wrapped at the bottom.

920.03.3 Bedding For Riprap. The bedding material shall be placed on the prepared slope or area to the full specified thickness of each layer shown on the Plans. Placement of stone bedding must proceed from the bottom up to the top of the slope. At no time will the stone bedding be dumped onto the fabric from the top of the slope and allowed to roll down the surface of the fabric. Bedding shall be placed in one operation, using methods which will preclude segregation of particle sizes within the layer. The surface of the finished layer should be reasonably even and free from mounds or windows. Additional layers of bedding material, when required, shall be employed which shall preclude the mixing of materials in different layers.

920.03.4 Dumped Riprap. Stone for riprap shall be placed on the prepared slope or area in a manner which will produce an evenly graded mass of stone with the minimum practical percentage of voids. The entire mass of stone shall be placed so as to conform with the lines, grades, and thicknesses shown on the Plans. Riprap shall be placed to its full course thickness in one operation and in such a manner as to avoid displacing the underlying material. Placing of riprap in layers, or by dumping into chutes, or by other methods likely to cause segregation will not be permitted.

The larger stones shall be well distributed and the entire mass of stone shall conform to the specified gradation as set forth in **Subsection M.10.03.2** of these Specifications. All material comprising riprap protection shall be placed and distributed to preclude large accumulations of either the larger or smaller sizes of stone.

It is the intent of these Specifications to produce a fairly compact riprap protection in which all sizes of material are placed in their proper proportions. Hand placing or rearranging of individual stones by mechanical equipment may be required to the extent necessary to secure the results specified.

When riprap and bedding material are dumped under water, thickness of the layers shall be increased as shown on the Plans. Placement methods shall be employed that will minimize segregation.

920.03.5 Placed Riprap. Stones for riprap shall be placed on a prepared slope in a pattern that contains minimum voids. The top surface of the riprap shall conform to a true and even plane with a tolerance of plus or minus 4 inches. Joints shall be broken as much as practicable, and joint openings to underlying soil shall be avoided by careful arrangement of stone sizes and the chocking of the openings with smaller stones. Larger stones shall be placed near the base of the slope. The stones shall be laid to rest on the bank, and not on adjacent stones. This shall be accomplished by laying stones from the top of the bank, downward, to insure independent support for each such stone.

920.04 METHOD OF MEASUREMENT.

920.04.1 Filter Fabric. “Filter Fabric for Riprap” will be measured by the number of square yards of exposed surface actually placed in accordance with the Plans and/or as directed by the Engineer. Overlapped portions of filter fabric will not be measured for payment.

920.04.2 Riprap and Bedding Material. "Riprap" or "Bedding Material" for riprap will be measured by one of the following units, each as actually placed in accordance with the Plans and/or as directed by the Engineer:

a. Cubic Yard. By the number of cubic yards as computed from surface area measurements parallel to the riprap surface and with the thickness measured normal to the riprap surface.

b. Ton. By the number of tons as measured by the actual scale weight, in tons, of the material actually placed.

c. Square Yard. By the number of square yards as computed from surface area measurements parallel to the riprap surface.

920.05 BASIS OF PAYMENT.

920.05.1 Filter Fabric. The accepted quantity of “Filter Fabric for Riprap” will be paid for at the contract unit price per square yard as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, and equipment, and all other incidentals required to finish the work, complete and accepted by the Engineer.

920.05.2 Riprap and Bedding Material. The accepted quantities of "Riprap" or "Bedding Material" for riprap of the various types and configurations indicated on the Plans will be paid for at their respective contract unit prices per cubic yard, per ton, or per square yard, as the case may be, as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, materials, and equipment, including excavation for riprap or bedding, preparation of subgrade, hauling and placing the material, and all other incidentals required to finish the work, complete and accepted by the Engineer.

Riprap placed outside the specified limits will not be paid for, and the Contractor may be required to remove and dispose of the excess riprap at no additional cost to the State.

SECTION 921

SLOPE PAVING

921.01 DESCRIPTION. This work consists of providing precast concrete blocks on a prepared gravel base on slope areas at the locations indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

921.02 MATERIALS. The nominal size of the concrete blocks shall be 16" x 8" x 4". The concrete shall be Class A(AE) and shall conform to **SECTION 601; PORTLAND CEMENT CONCRETE**, of these Specifications. Mortar for the joints shall conform to **Subsection M.04.03.5** of these Specifications.

Gravel borrow shall conform to the requirements of **Subsection M.01.02; Gravel Borrow**, of these Specifications.

921.03 CONSTRUCTION METHODS. The blocks shall be laid on a compacted gravel base spaced to provide 3/8-inch joints. Vertical joints shall be staggered to the center of each block. The finish surface of the slope paving shall be reasonably smooth and true to the finish grades and sections indicated on the Plans. Mortar for all joints shall be poured over the blocks and thoroughly brushed into the 3/8-inch space to the full depth of the joint.

921.04 METHOD OF MEASUREMENT. "Slope Paving" will be measured by the number of square yards in the face area of the surface actually paved in accordance with the Plans and/or as directed by the Engineer.

921.05 BASIS OF PAYMENT. The accepted quantity of "Slope Paving" will be paid for at the contract unit price per square yard as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, and equipment, and all other incidentals required to finish the work, complete and accepted by the Engineer.

SECTION 922

TEMPORARY CONSTRUCTION SIGNS

922.01 DESCRIPTION. This work consists of providing temporary construction signs at the locations indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

922.02 MATERIALS.

922.02.1 Sign Construction. Plywood or aluminum sheeting, reflective sheeting, wood posts, and other materials shall conform to the applicable requirements of **SECTION M.16; SIGNS AND SIGN SUPPORTS**, of these Specifications.

922.03 CONSTRUCTION METHODS.

922.03.1 Design and Fabrication. Signs provided under this Specification shall conform in type, size, dimensions, color, design, and placement to the schematic drawings contained in the current edition of the Manual on Uniform Traffic Control Devices, including the latest corrections and additions thereto, and as indicated on the Plans.

Signs and devices shall be erected prior to the beginning of the work as directed. No work shall proceed until the necessary signs have been erected. The signs shall be immediately removed when the need no longer exists as determined by the Engineer, and shall be replaced without cost to the State if, in the opinion of the Engineer, they are damaged to the extent that the original purpose of erection is no longer being served.

All signs shall be reflectorized in accordance with **Subsection M.16.02** of these Specifications, shall be well constructed, legible, and have a fresh, clean appearance. Sign standards and their location shall conform to the applicable provisions of the Manual on Uniform Traffic Control Devices published by the U. S. Government Printing Office.

The Contractor shall be required to provide the number and type of construction warning and guide signs ordered by the Engineer. Signs shall be reused as required or directed by the Engineer at the various locations as the sequence of construction progresses. This work shall be performed at no additional expense to the State.

All signs shall be continuously maintained to the satisfaction of the Engineer. All damaged signs shall be replaced and repaired with reasonable immediacy.

922.03.2 Sign Mountings. Temporary construction sign mountings shall conform to the details indicated on the Plans.

a. Portable Support Systems. When construction operations are such that wood post mounting is impractical, temporary construction signs shall be mounted on portable support systems specifically designed for such use. Such support systems may be one of those products which appear on the Department's Approved Materials List.

In no case will the bottom of the sign be mounted less than one foot above the surface upon which traffic is required to ride during the time the signs are in place.

922.04 METHOD OF MEASUREMENT. "Temporary Construction Signs" will be measured by the number of square feet of such signs actually provided in accordance with the Plans and/or as directed by the Engineer.

922.05 BASIS OF PAYMENT. The accepted quantity of "Temporary Construction Signs" will be paid for at the contract unit price per square foot as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, and equipment, including mountings, placing signs at their initial locations and for eventually removing said signs from their final locations, and all other incidentals required to finish the work, complete and accepted by the Engineer.

Payment for removing temporary construction signs from their initial locations and for handling, maintaining, transporting, and relocating said signs to storage or to subsequent intermediate locations at which they are to be used for traffic control is not included in this Section but is included under **SECTION 937; MAINTENANCE AND MOVEMENT OF TRAFFIC PROTECTIVE DEVICES**, of these Specifications.

SECTION 923

PORTABLE CHANNELIZING DEVICES AND BARRICADES

923.01 DESCRIPTION.

923.01.1 General. This work consists of providing portable barricades of various types and configurations at the locations indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications and MUTCD standards.

923.01.2 Types of Portable Channelizing Devices and Barricades. The following types of portable barricades are currently in use by the Department:

a. PVC Plastic Pipe Barricade (MUTCD, Type III).

b. Plastic Pipe Barricade with Sandbag Base (MUTCD, Type III).

c. Polyethylene Drum Barricade.

d. Fluorescent Traffic Cones.

923.02 MATERIALS.

923.02.1 PVC Plastic Pipe. Plastic pipe shall be white polyvinyl chloride pressure rated, Class SDR 21 or SDR 26, conforming to the applicable requirements of either ASTM D2241 or ASTM D2729.

923.02.2 Polyethylene Plastic Pipe. Pipe shall be white, rotationally moulded polyethylene plastic conforming to the applicable requirements of ASTM D1248, Class II A3-E4 or Class II A4.

923.02.3 Polyethylene Drum. The drum shall be manufactured from polyethylene plastic in accordance with details indicated on the Plans and in conformance with MUTCD standards.

923.02.4 Fluorescent Traffic Cones. Cones shall be a plastic, fluorescent, commercially produced product that conforms to the details indicated on the Plans. The conical upper portion shall be 100 percent polyvinyl chloride having a highly pigmented, non-injurious fluorescent red-orange color. The upper section shall be fused to a non-painted white base in accordance with the manufacturer's recommendations.

923.03 CONSTRUCTION METHODS.

923.03.1 Design and Fabrication. Portable barricades and devices provided under this Specification shall conform in type, size, dimension, color and design with their respective details as indicated on the Plans. Barricades shall be sturdily constructed, freshly painted, and shall present a clean and neat appearance. Messages shall be clearly legible. Barricades shall be painted and reflectorized in accordance with requirements set forth in other paragraphs of this Specification.

924.03.2 Placement. The Contractor shall provide the number and types of portable barricades and devices as indicated on the Plans or as directed by the Engineer. Barricades and devices shall be erected prior to the time actual construction work commences. Conversely, no construction work shall take place until the required barricades have been erected. Barricades shall remain in place until the Engineer determines that they are no longer needed at a given location. They shall be reused as directed by the Engineer at other locations as the sequence of construction progresses.

Care shall be exercised during transporting, storing, and placement of barricades and devices to prevent damage. No damaged barricades or devices shall be placed. Barricades and other traffic protection devices showing defects or damage as a result of the Contractor's operations or negligence shall be removed and replaced at no additional cost to the State.

923.04 METHOD OF MEASUREMENT.

923.04.1 Plastic Pipe Barricades. "Plastic Pipe Barricades" and "Plastic Pipe Barricades with Sandbag Bases" will be measured by the respective number of each such units actually provided in accordance with the Plans and/or as directed by the Engineer.

923.04.2 Drum Barricades. "Polyethylene Drum Barricades" will be measured by the number of barrel-days such barricades are actually in place in accordance with the Plans and/or as directed by the Engineer.

923.04.3 Fluorescent Traffic Cones. "Fluorescent Traffic Cones" will be measured by the number of each such cone actually provided in accordance with the Plans and/or as directed by the Engineer.

923.05 BASIS OF PAYMENT.

923.05.1 Plastic Pipe Barricades. The accepted quantities of "Plastic Pipe Barricades" and "Plastic Pipe Barricades with Sandbag Bases" will be paid for at their respective contract unit prices per each unit as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, material, and equipment, including placing barricades and devices at their initial locations and for eventually removing said barricades and devices from their final locations, and all other incidentals necessary to finish the work, complete and accepted by the Engineer.

923.05.2 Drum Barricades. The accepted quantity of "Polyethylene Drum Barricades" will be paid for at the contract unit price per barrel-day as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, material, and equipment including fabrication, reflective sheeting, placing drum barricades at their initial locations and for eventually removing said drum barricades from their final locations, maintenance, replacement (in the event of unacceptable damage), temporary storage, and all other incidentals necessary to finish the work, complete and accepted by the Engineer.

923.05.3 Fluorescent Traffic Cones. The accepted quantity of "Fluorescent Traffic Cones" will be paid for at the contract unit price per each such cone as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, material, and equipment, including placing cones at their initial locations and for eventually removing said cones from their final

locations, and all other incidentals necessary to finish the work, complete and accepted by the Engineer.

Payment for removing barricades and traffic cones from their initial locations and for hauling, maintaining, transporting, and relocating said barricades and traffic cones to storage or to subsequent intermediate locations at which they are to be used for traffic control is not included in this Section but is included under **SECTION 937; MAINTENANCE AND MOVEMENT OF TRAFFIC PROTECTIVE DEVICES**, of these Specifications.

SECTION 924

ADVANCE WARNING ARROW PANEL

924.01 DESCRIPTION. This work consists of providing, operating and maintaining a portable trailer on which is mounted a flashing "arrow" unit at locations indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications and MUTCD standards.

924.02 MATERIALS.

924.02.1 Trailer. The trailer shall be a portable, rubber-tired unit.

924.02.2 Flashing Arrow Unit. The flashing "arrow" unit consists of a black background panel constructed of light weight aluminum. The panel shall be approximately 4 feet high and 8 feet wide. It shall be wired and have receptacles for at least 12 No. 4412A amber sealed beam lamps, or approved equal. Each such lamp shall have a maximum initial intensity of 6,000 candle power and a flash rate of approximately 30 flashes per minute. The unit shall be provided with a locking switch box and an automatic dimming device capable of reducing maximum lamp intensity by at least 50 percent during nighttime operation.

The flashing arrow unit shall be capable of indicating a bar (warning mode), an arrow to the left, an arrow to the right, or an arrow in both directions simultaneously to approaching traffic.

924.02.3 Power Supply. The portable flashing arrow unit shall be powered by diesel fuel. The generator shall be equipped with battery powered backup. The portable flashing unit shall also be provided with a hardwire capability.

924.03 CONSTRUCTION METHODS. The advance warning arrow panel shall be available for use throughout the duration of the Contract. It shall be positioned and repositioned at the direction of the Engineer.

The Contractor shall be required to perform all maintenance recommended by the manufacturer of the units, as required to keep the unit operating properly. Said maintenance shall include the periodic cleaning of the units.

The units shall be kept in good repair at all times. If there is a failure, malfunction, or damage to the unit for any reason, the Contractor will expedite the repair and furnish adequate

flaggers or other approved means to provide a safe means for control or traffic until the units are put back into service.

924.04 METHOD OF MEASUREMENT. "Advance Warning Arrow Panels" will be measured by number of days the unit is actually employed in the construction work in accordance with the Plans and/or as directed by the Engineer.

924.05 BASIS OF PAYMENT. The accepted quantity of "Advance Warning Arrow Panels" will be paid for at the contract unit price per day as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, and equipment including the unit itself, first placement thereof, temporary storage, repositioning at different locations, diesel fuel, electric power, batteries, maintenance, and all other incidentals necessary to finish the work, complete and accepted by the Engineer.

SECTION 925

PORTABLE CHANGEABLE MESSAGE SIGN

925.01 DESCRIPTION. This work consists of providing, operating and maintaining a portable trailer on which is mounted a changeable message sign at locations indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications and MUTCD standards.

925.02 MATERIALS.

925.02.1 Trailer. The trailer shall be a portable, rubber tired unit.

925.02.2 Message Sign. The sign shall consist of either a lamp matrix or a rectangular disk matrix system capable of a flash and sequence rate of one to six seconds. The message displayed from the unit shall be visible from a distance of one-half mile and have an average legibility distance of 850 feet under conditions of normal sunlight.

a. The Lamp Matrix Sign. The sign shall consist of a three line, eight character/module matrix. Each character/module shall be a minimum of 17 inches high and shall be configured in a 7 by 4 dot matrix. All characters/modules within a message line shall be equally spaced, both horizontally and vertically.

Under a normal operation range of 9 volts to 20 volts, the clamp matrix bulbs shall have a projected design life of 10,000 hours. The bulb shall be a two-inch diameter, par-16, sealed beam, double contact bayonet base unit.

All lamp matrix characters/modules shall have their own lamp driver circuit board mounted on and connected to the back side. The characters/modules shall be hinged to the bottom on the lamp board for ease of maintenance and repairs. All lamp matrix characters/modules are to be interchangeable.

The lamp matrix sign shall be protected from sun-glare by a sunscreen assembly of seventeen louvers per vertical inch at a 20 degree tilt.

The controller will be an all solid state unit. A keyboard entry system shall be provided to allow an operator to generate a number of messages. The keyboard shall be equipped with a security lock-out feature to prevent unauthorized use of the controller.

The controller will contain a non-volatile memory to hold the keyboard created messages in memory during a non-power period.

The controller will have a local message display panel to show the message either being displayed on the sign or being created on the keyboard. In addition, this display panel will be capable of giving the operator all programming instructions.

The controller cabinet, with lockable door, shall be mounted on the forward part of the trailer so the operator is viewing traffic while performing operations on the controller. This cabinet shall have an interior light for night operation and programming.

The power unit for operating the entire sign system shall be a heavy duty, diesel powered generator with a battery backup system.

b. The Disk Matrix Sign. The sign shall consist of a three line, eight character/module matrix. Each character/module shall be a minimum of 18 inches high and shall be configured in a seven-disk high by five-disk wide matrix. The disks shall be painted fluorescent yellow on one side and flat black on the other.

The disk matrix sign shall be equipped with four, 108-inch black-lites for nighttime operation. The black-lites are to be arranged inside the enclosure on both the top and bottom of each line. The front cover shall be hinged for ease of service and each character/module shall be interchangeable with all other characters.

The controller shall consist of a lap top computer keyboard and a liquid crystal display which will allow an operator to generate a number of different messages. The "create message" option shall only be accessible by use of a password to avoid unauthorized use of the controller.

The controller cabinet with lockable door, shall be mounted on the forward part of the trailer so the operator is viewing traffic while performing operations on the controller. This cabinet shall have an interior light for night operation and programming.

The power unit for operating the entire sign system shall be a heavy duty diesel powered generator with a battery backup system.

925.03 CONSTRUCTION METHODS. The changeable message sign shall be available for use throughout the duration of the Contract. It shall be positioned and repositioned at the direction of the Engineer.

The Contractor shall be required to perform all maintenance recommended by the manufacturer of the units, as required to keep the unit operating properly. Said maintenance shall include the periodic cleaning of the units.

The units shall be kept in good repair at all times. If there is a failure, malfunction, or damage to the unit for any reason, the Contractor will expedite the repair and furnish adequate flaggers or other approved means to provide a safe means for control of traffic until the units are put back into service.

925.04 METHOD OF MEASUREMENT. "Portable Changeable Message Signs" will be measured by number of days the unit is actually employed in the construction work in accordance with the Plans and/or as directed by the Engineer.

925.05 BASIS OF PAYMENT. The accepted quantity of "Portable Changeable Message Signs" will be paid for at the contract unit price per day as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, and equipment including the unit itself, first placement thereof, temporary storage, repositioning at different locations, diesel fuel, electric power, batteries, maintenance, and all other incidentals necessary to finish the work, complete and accepted by the Engineer.

SECTION 926

PRECAST CONCRETE MEDIAN BARRIER FOR TEMPORARY TRAFFIC CONTROL

926.01 DESCRIPTION. This work consists of providing precast concrete median barrier for temporary traffic control at locations indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

926.02 MATERIALS.

926.02.1 Median Barrier Units. Portland cement concrete and reinforcing shall conform to the requirements of **Subsection 909.02.1** of **SECTION 909; PRECAST CONCRETE MEDIAN BARRIER**, of these Specifications.

926.02.2 Delineators. Delineators shall have a minimum of 6½ square inches of reflective surface area. The unit shall be capable of being mounted on the side of barrier by use of an adhesive or other method approved by the manufacturer. Such delineators may be one of those products which appear on the Department's Approved Materials List.

926.03 CONSTRUCTION METHODS.

926.03.1 Plant Requirements. Plant requirements shall conform to the applicable provisions of **Subsection 909.03.1** of **SECTION 909; PRECAST CONCRETE MEDIAN BARRIER**, of these Specifications.

926.03.2 Delineators. White delineators shall be installed on the right side of the travel way and amber delineators on the left side of the travel way. The delineators shall be installed at 50-foot intervals and they shall be located 3 inches from the top of the concrete barriers.

926.03.3 Placement. Precast concrete median barrier used for temporary traffic control shall be placed on the pavement at locations indicated on the Plans or as directed by the Engineer. Upon completion of the work the Contractor shall remove said barrier units from the project site.

Care shall be exercised during transporting, storing, hoisting and handling of the units to prevent cracking or damage. No damaged units or units that have markings painted on them from previous work-sites shall be installed. Units showing defects or damage as a result of the Contractor's operations or negligence shall be removed and replaced or repaired by the Contractor at no additional cost to the State.

926.04 METHOD OF MEASUREMENT.

926.04.1 Median Barrier Units. "Precast Concrete Median Barrier for Temporary Traffic Control" will be measured in linear feet of continuous runs of those units actually placed in accordance with the Plans and/or as directed by the Engineer. The measured length includes all 3-inch joints between the units.

926.04.2 Delineators. "Reflective Delineators" will be measured by the number of each such unit actually provided in accordance with the Plans and/or as directed by the Engineer.

926.05 BASIS OF PAYMENT.

926.05.1 Median Barrier Units. The accepted quantity of "Precast Concrete Median Barrier for Temporary Traffic Control" will be paid for at the contract unit price per linear foot as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, and equipment, including placing the units at their initial locations and for eventually removing said units from their final locations, and for all other incidentals required to finish the work, complete and accepted by the Engineer.

The Contractor shall be paid 90 percent of the contract unit price when the barrier units are in place. The remaining 10 percent of the contract unit price will be paid when the barrier units have been removed from the project.

926.05.2 Delineators. The accepted quantity of "Reflective Delineators" for median barrier units will be paid for at the contract unit price per each as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, and equipment, including surface preparation and adhesives, and for all other incidentals required to finish the work, complete and accepted by the Engineer.

Payment for removing barrier units from their initial locations and for hauling, maintaining, transporting, and relocating said barrier units to storage or to subsequent intermediate locations at which they are to be used for traffic control is not included in this Section but is included under **SECTION 927; REMOVE AND RELOCATE PRECAST CONCRETE MEDIAN BARRIER FOR TEMPORARY TRAFFIC CONTROL,** of these Specifications.

SECTION 927

REMOVE AND RELOCATE PRECAST CONCRETE MEDIAN BARRIER FOR TEMPORARY TRAFFIC CONTROL

927.01 DESCRIPTION. This work consists of removing precast concrete median barrier from one location and subsequently installing said barrier at an alternate location as indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

927.02 MATERIALS. Not applicable.

927.03 CONSTRUCTION METHODS. Precast concrete median barrier units shall be carefully removed from their initial locations and transported to alternate locations where they shall be placed on the pavement as directed by the Engineer.

Care shall be exercised during hauling, hoisting and handling of the units to prevent cracking or damage. The Contractor shall be responsible for replacing or repairing all units damaged by his operations.

The Contractor shall relocate the precast concrete median barrier units in such manner as not to leave exposed blunt ends of said units. The Contractor shall not violate the open lane requirements set forth elsewhere in these Specifications.

927.04 METHOD OF MEASUREMENT. "Remove and Relocate Precast Concrete Median Barrier for Temporary Traffic Control" will be measured in linear feet of continuous runs of these units actually moved to the new locations in accordance with the Plans and/or as directed by the Engineer.

927.05 BASIS OF PAYMENT. The accepted quantity of "Remove and Relocate Precast Concrete Median Barrier for Temporary Traffic Control" will be paid for at the contract unit price per linear foot relocated as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, tools, for hauling, handling, equipment, temporarily storing units off the roadway, any new parts required to secure the units to the pavement or to adjacent units, and all other incidentals necessary to finish the work, complete and accepted by the Engineer.

The Contractor will not be compensated for any work necessary to realign median barrier units if they are disturbed during construction as a result of the Contractor's operations.

Payment for providing the barrier units at their initial locations and for removing said units from their final locations at which they were used for traffic control is not included under this Section but is included under **SECTION 926; PRECAST CONCRETE MEDIAN BARRIER FOR TEMPORARY TRAFFIC CONTROL,** of these Specifications.

SECTION 928

TRUCK MOUNTED ATTENUATOR (TMA) WITH TRUCK MOUNTED FLASHING ARROW BOARD (TMFAB)

928.01 DESCRIPTION. This work consists of providing, operating, and maintaining truck mounted energy absorbing impact attenuators, replacement attenuator cartridges, and truck mounted flashing arrow boards, at the locations indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

928.02 MATERIALS.

928.02.1 Truck Mounted Attenuator (TMA). The TMA is a lightweight attenuation system designed for installation at the back of traffic control trucks. It consists of three basic component sections - a crushable module, a lightweight steel backup, and a support frame for attaching the backup to the truck.

The complete TMA shall be designed to make attachment or detachment from the truck simple and fast and shall be installed in accordance with the manufacturer's recommendations.

a. Module Materials. Light fixtures shall consist of combination run, turn, brake, and side clearance lights with ICC identification lights on the rear of the TMA. All light fixtures shall have rubber grommet seals. A standard SAE/AT/TTMA interchangeable 7-way trailer light wire connector shall be installed and wired to SAE standards.

All standard modules shall have a chevron pattern painted on the rear of the module. The standard chevron pattern shall have 4-inch wide stripes, alternating black and yellow, slanted at 45 degrees in an inverted "V" form with the "V" located at the center of the module.

All standard modules assembly shall be covered for debris containment during an impact and for environmental protection.

b. Crushable Frame. The crushable frame which supports the TMA assembly shall be fabricated from standard steel shapes. The module shall be fastened to the internal frame.

c. Steel Backup. The steel backup shall be special lightweight assembly which shall support the TMA cartridge during normal use and shall resist the loads applied to it during impacts. This backup shall be capable of tilting upward toward the truck 90 degrees for travel or storage. Positions will be either 90 degrees or horizontal.

d. Attachment to the Truck. The TMA shall be designed to interface with a truck as specified herein. Engineers from the TMA manufacturers shall be supplied with a dimensional layout sheet of the truck to which the TMA will be attached. The interface structure between the TMA and the truck will then be custom fabricated by TMA manufacturers.

e. Metal Work-Fasteners. All metal work shall be fabricated from ASTM A36 or M1020 merchant quality steel. After fabrication, all metal work shall be coated with metal primer and

painted black. All welding shall be done by, or under the direction of, a certified welder. All bolts, nuts, and washers shall be corrosion resistant American National Standard.

f. Wire Rope. All wire ropes shall be 3/8-inch diameter galvanized, 7 x 19 aircraft cable manufactured to Military Specifications.

g. Weight. The TMA with 90-degree tilt shall weigh approximately 1200 pounds.

h. Hydraulics. The TMA with 90-degree tilt shall have a 12 volt D.C. hydraulic pump and cylinder which will be used to tilt the Hex-Foam module 90 degrees up from horizontal position. The hydraulic pump shall be supplied with a remote activation switch.

i. Wheel Jacks. The TMA with 90-degree tilt shall be capable of accepting two hand crank swivel jacks and two swing jacks at the rear to assist in the removal of the module and backup from the truck. These jacks shall have wheels to provide portability of the TMA once it is removed from the truck.

j. Testing Criteria. The TMA until shall have been tested to the criteria as listed in the National Cooperative Highway Research Program No. 350, dated 1993. A copy of the results of such testing must be available upon request and have been written by a Registered Professional Engineer. The TMA shall be capable of passing the following tests:

1. Vibration. Eight hours of constant vibration with a frequency of 5 HZ and a minimum amplitude of .5-inch, input at the base of the backup. The intent of this test is to simulate worst case road vibrations.

2. Moisture. Twenty-four hours of simulated rain on the top of the unit at the rate of 10 inches per hour. Twenty-four hours of simulated rain on the bottom of the unit at 10 inches per hour. The test should result in no water accumulation or moisture absorption by the module material.

3. Corrosion. When subjected to 50 hours of salt spray (fog), in accordance with ASTM B117, the energy absorbing material shall show no signs of corrosion or decrease in the energy absorbing capacity of the material.

928.02.2 Replacement Cartridges. The Contractor shall have a replacement cartridge available at all times. In the event that the original TMA is damaged due to a crash of an oncoming vehicle during construction the replacement cartridge will be used. The replacement cartridge shall include the module, internal support system, and hydraulic jacks. If the original TMA is damaged, the replacement cartridge will be used and a third cartridge will be ordered and paid for on a Force Account basis as set forth in **Subsection 109.04, Para. a.4** of these Specifications.

928.02.3 Truck Mounted Flashing Arrow Board (TMFAB). Attached to the traffic control truck, as described herein, shall be an illuminated truck mounted flashing arrow board. The TMFAB shall be a 4 foot by 8 foot board mounted at the rear of the truck.

The TMFAB shall contain at least 12 #4412A (or equal) amber lights each of which shall have approximately 6,000 initial maximum candle power with a flash rate of approximately 30 per minute and which shall indicate an arrow to the left, an arrow to the right or an arrow to both sides

simultaneously to warn approaching traffic. The center of the arrow shall be mounted a minimum of 9 feet above the roadway. For nighttime use the unit shall be equipped for lamp intensity reduction to eliminate glare.

The TMFAB shall be powered by a diesel-fueled generator equipped with backup batteries.

928.02.4 Traffic Control Truck. The Contractor shall provide a truck weighing between 10,000 pounds to 24,000 pounds or one specified by the manufacturer and approved by the Engineer. The truck shall be adaptable to mounting the TMA and TMFAB to the rear of the truck.

928.03 CONSTRUCTION METHODS. The TMA and TMFAB shall be available for use throughout the duration of the Contract. It shall be positioned and repositioned at the direction of the Engineer.

The Contractor shall properly maintain the TMA and TMFAB throughout the Contract period.

928.04 METHOD OF MEASUREMENT. "Truck Mounted Attenuator with Truck Mounted Flashing Arrow Board" will be measured by the number of days each such assembly is actually employed in the work or as directed by the Engineer.

928.05 BASIS OF PAYMENT. The accepted quantity of "Truck Mounted Attenuator with Truck Mounted Flashing Arrow Board" will be paid for at the contract unit price per day as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, and equipment, including the TMA module, steel backup, TMA support frame, hydraulic pumps, wheel jacks, the continuous repositioning thereof, the first replacement TMA cartridge, TMFAB, TMFAB support frame for attachment to the truck, generator, and all incidentals required to finish the work, complete and accepted by the Engineer.

No additional payment will be made for the provision of the traffic control truck.

SECTION 929

FIELD OFFICES AND MATERIALS LABORATORY

929.01 DESCRIPTION. This work consists of providing and maintaining an adequate, weatherproof field office or materials laboratory for the exclusive use of the Engineer and his staff during both the contract period and for a maximum of 60 days thereafter, all in accordance with these Specifications.

929.02 GENERAL REQUIREMENTS.

929.02.1 Location. The field office or materials laboratory shall be located on a site that is both satisfactory to the Engineer and convenient to the project site.

929.02.2 Minimum Spatial Requirements. Unless specified otherwise in the Special Provisions of the Contract, the Engineer's field office or materials laboratory each shall contain a minimum of 240 square feet of floor area and 7 feet of headroom. It shall contain a sufficient number of windows to provide at least 27 square feet of natural light.

Existing building structures meeting the above minimum requirements are considered acceptable.

929.02.3 Other Requirements.

a. The Contractor shall be responsible for arranging and complying with all necessary local and State regulatory permits and inspections, including all costs associated therewith.

b. The Engineer's field office or materials laboratory shall be fully equipped and ready for occupancy at least two days prior to the start of actual construction operations.

c. The Contractor shall protect the field office and/or materials laboratory against fire, flooding, and theft throughout the 24 hours of every day the unit is in service. The Contractor shall be responsible for the loss of any property belonging to the State that is housed therein due to theft, fire, or natural causes.

d. At the time either the field office or materials laboratory is made available to the State, the Contractor shall furnish evidence to the Engineer that adequate insurance has been obtained which protects the State against loss of property from theft, fire, or natural causes.

In the event of fire, theft, or equipment breakdown, all equipment involved shall be repaired or replaced by the Contractor as soon as possible. In the event the field office or materials laboratory is destroyed or rendered untenable for any reason, it shall be replaced by the Contractor within two weeks, or as directed.

929.03 SPECIFIC REQUIREMENTS. The field office and/or materials laboratory shall be provided for as follows:

929.03.1 Outside Utilities.

a. Electrical Power. The Contractor shall arrange for electrical service for the field office or materials laboratory and provide the necessary meter connections, fuse box and switches as required by the power company, all in accordance with State and local building codes. The power supply shall be 115-volt, 60-cycle current of sufficient amperage to provide for heat, interior and exterior lighting, operating office equipment and air conditioning.

b. Sanitary Sewer Outfall. The Contractor shall provide an adequate temporary outfall into either the municipal sanitary sewer system or an individual sewage disposal system that has been approved by the R.I. Department of Environmental Management. Disposal of sanitary wastes must conform to the applicable requirements of both the R.I. Department of Environmental Management and municipal regulations.

c. Security. All office or laboratory trailer units shall be enclosed within a 6-foot chain link fence with adequate gates and locks. Outside area floodlighting, together with appropriate timers, shall be provided on all four sides of trailers.

929.03.2 Interior Utility Services.

a. Lighting. Lighting fixtures as required to provide minimum illumination of 70 foot-candles in all areas.

b. Electrical Receptacles. Six duplex convenience electrical receptacles shall be located throughout the field office or materials laboratory as directed by the Engineer. At least two of these receptacles shall be 20-amp capacity.

c. Heating and Air Conditioning. Heating equipment capable of maintaining a year round temperature between 70°F and 78°F.

d. Sanitary Facilities. A water closet, lavatory, slop sink, vent fan, and a hot water heater of a minimum 5-gallon capacity shall be provided.

e. Telephone. Telephone service and instrument for one incoming line.

929.03.3 Doors and Windows. Doors shall be stock sizes and shall have a key-in-knob lock of an approved manufacturer. All doors shall be keyed alike. All windows shall be operative except for picture windows. Operative windows shall be either double hung or casement type equipped with adequate locks. All windows shall be provided with either shades or venetian blinds. All window openings shall be adequately screened. Windows in sanitary areas shall have frosted glass.

929.03.4 Furnishings and Equipment. Both the field office and materials laboratory will be provided with the following:

a. Furnishings.

1. One work table, 30 inches high, with a minimum of 24 square feet of work area.

2. One drafting stool.

3. Two folding-type chairs.

4. One fire resistant drawer-type safe, legal size, with combination or key lock.

5. One four-drawer legal size metal filing cabinet equipped with lock.

6. Two two-drawer (14½" x 16") metal filing cabinets.

7. Two round wastebaskets.

8. One plan rack of an approved design to be equipped with 10 rods.

b. Equipment.

1. A 5-pound CO_2 fire extinguisher of approved manufacture shall be furnished for each 200 square feet of floor area.

2. A 115-volt, 60-cycle rotating fan.

3. One First-Aid Kit.

4. One electric sanitary water cooler with refrigerated storage compartment; supply with paper cups.

5. Toilet paper holders, paper towel dispensers and soap dispensers in the toilet rooms.

929.03.5 Special Requirements for Field Office. The field office will also be provided with the following:

a. Furnishings.

1. Three office type desks, minimum top dimensions 32" x 60", with two or more drawers on each side.

2. Three swivel desk chairs.

b. Equipment.

1. Two fully automatic electronic calculators with tape.

2. One electric typewriter, with ribbon as required, mounted on typewriter table on casters.

3. One office type copying machine.

4. One pencil sharpener.

c. Computer Equipment. The items of computer equipment and software to be furnished, installed, tested, made operational and maintained within the Field Office are set forth in **Special Provision Code 929.1000**.

Failure to furnish, install, make operational and maintain the field office equipment and peripheral equipment/accessories specified under **Subsection 929.03.5**, will result in delay to the processing of progress payments.

929.03.6 Special Requirements for Materials Laboratory. The materials laboratory will also be provided with the following:

a. Furnishings.

1. One office type desk, minimum top dimensions 32" x 60", with two or more drawers on each side.

2. One swivel desk chair.

b. Work Table and Sink. The materials laboratory shall be provided with a deep sink set in a work table, and equipped with a faucet and a drain to the outside of building. A water supply sufficient for testing shall be provided. The water supply may consist of a gravity feed tank with at least a 50-gallon capacity or be provided from municipal sources.

c. Concrete Curing Box. A concrete cylinder curing box shall be provided. The concrete cylinder curing box shall conform to the following minimum requirements: It shall have approximate internal dimensions of 42 inches in length; 18 inches in width; and 19 inches in depth. The top of the box shall be an insulated lid, hinged at the back and with a lock at the front. The interior of the box shall be made of 16 gauge, rustproofed steel. The outside of box shall be separated from the inside by 2 inches of rigid foam insulation. A moisture-proof seal between the lid and the box shall be provided. The inside container shall be constructed such that heat and humidity requirements will be supplied by a 1,000-watt immersible heater in a pool of water at the bottom of the container, approximately 4 inches deep. A drain pipe shall be provided through the side of the box. Suitable means of support shall be provided to hold the concrete cylinders above the water surface. A bi-metallic thermometer which can be read from outside shall be installed to measure the internal temperature of the box. This thermometer shall have minimum graduations of 2^{O}F. A thermostat shall maintain the water at a uniform temperature of 73°F ± 3°F when the ambient temperature is as low as -10°F.

1. Equal Characteristics. A concrete curing box of a design and manufacture different from that described above, but which possesses equal characteristics may be employed provided that it is approved in writing by the Engineer.

d. Equipment. The Contractor shall provide the materials laboratory with the following additional equipment.

1. One Gilson Testing Sieve Shaker (Model TS-1), or equivalent, consisting of ten changeable screens mounted on a concrete base. Screens shall be calibrated to U.S. Standard tolerances and shall consist of the following sizes: 3", 2½", 2", 1½", 1", 3/4", ½", 3/8", No. 4, No. 8, and pan.

2. One motor-driven sieve shaker for operation on 115-volt, 60-cycle single phase current complete with belt driven mechanism to produce combination rocking and tapping action, and with capacity for 8 full height sieves plus pan and cover; all parts mounted on a sturdy base.

3. One set of brass-frame United States Standard testing sieves, all to be full height, 8 inches in diameter, matched for nesting, and consisting of the following sizes: ½", 3/8", Nos. 4, 8, 16, 40, 50, 100, two No. 200 mesh sieves, each with No. 14 mesh backing, two pans and one cover.

4. One two burner electric hot-plate; UL approved.

5. Eight drying pans (10" x 14" x 2" minimum) of sturdy 12-gauge metal.

6. One approved digital scale with a minimum capacity of 2,000 grams and with sensitivity of 0.10 gram.

7. One platform beam scale, with pan that can be tared on scale capacity 200 pounds, sensitivity of 0.01 pound, with two beams at front of platform, reading the 20 pounds by single pounds and to 1 pound by 0.01 pounds with additional hanger weights to fulfill capacity of 200 pounds; all parts to be steel with enclosed weighing mechanisms: platform to be 12½" x 14".

8. Scales must be calibrated every six months and must conform to the requirements of applicable Specifications and Standards.

e. Hardware and Accessories. The following hardware and accessories shall be provided:

1. One sample splitter ½-inch chute width - 16 chutes.

2. One sample splitter 2½-inch chute width - 8 chutes.

3. One brass-wire briquette brush.

4. Three, one-inch sieve or sash brushes (fine).

5. One rubber mallet.

6. One large sampling spoon.

7. One large scoop.

8. One trowel.

9. One square shovel.

10. One spade shovel.

11. Two pairs insulated gloves, "Hot Mitts", as required.

12. One thermometer - Gardo Model GT-300-R or equivalent, having an operating range of $0^{O}F$ to $220^{O}F$ with 6-inch stem and 3-inch diameter dial face, with calibrating capabilities.

13. One thermometer - Gardo Model GT-300-R or equivalent, having an operating range of $50^{O}F$ to $500^{O}F$ with a 9-inch stem and 3-inch diameter dial face with calibrating capabilities. The head should be capable of withstanding temperatures of at least $360^{O}F$.

929.03.7 Maintenance and Custodial Service. The Contractor shall provide the following maintenance and custodial services.

a. Maintenance. All necessary repairs of damaged, defective, or vandalized parts of the field office or materials laboratory and their associated furnishings and equipment. Maintenance operations shall continue as long as the field office or materials laboratory is occupied by the Engineer.

b. Custodial.

1. Weekly trash removal.

2. Bi-weekly floor cleaning.

3. Bi-monthly window cleaning.

4. Snow plowing, sanding and removal of snow at parking areas and walks.

5. Replacement of supplies as required to maintain office equipment and sanitary facilities.

929.03.8 Project Sign. Both the field office and the materials laboratory shall be equipped with a sign for the purpose of identifying the use of the structure and providing notice against trespassing. The Field Office Identification Sign is detailed on the Plans.

929.04 METHOD OF MEASUREMENT. "Field Office" and "Materials Laboratory" will both be measured by the number of calendar months said facilities are used under the Contract.

929.05 BASIS OF PAYMENT. "Field Office" and "Materials Laboratory" will be paid for at their respective contract unit prices per month as listed in the Proposal. The prices so-stated constitute full and complete compensation for furnishing, maintaining, and subsequently removing the field office or materials laboratory, together with all associated costs of computer equipment and peripherals and supplies, facsimile modems, including all costs associated with electrical utility, heating, lighting, air conditioning, water, sewer and telephone connections, permits, identification sign, maintenance, custodial services and supplies, and all other incidentals required to provided this service, complete and accepted by the Engineer.

The timely provision of field offices and materials laboratories for use by the State's engineering force shall be mandatory consideration for initial payments to the Contractor for any and all work performed.

SECTION 930

PLANT FIELD LABORATORY

930.01 DESCRIPTION. This work consists of furnishing a building at the site of the production plant suitable for the housing and use of equipment required to carry out the various tests and for the recording and processing of the results of said tests, all in accordance with these Specifications.

The building shall be for the exclusive use of the Engineer or his representatives for the purpose of testing and recording the results of said testing.

930.02 LABORATORY BUILDING. The laboratory building shall not be less than 16 feet wide and 12 feet long and shall have a ceiling height of at least 7½-feet. The floor shall be sturdy, level, and constructed of concrete. The building shall be watertight. There shall be at least three standard windows and a door equipped with an adequate lock. The site shall include restroom facilities that are fully equipped and accessible.

If the Engineer permits, the Plant Field Laboratory may be part of an existing building. In this case, the laboratory portions of the building shall be entirely partitioned off from the remaining unrelated areas. The use of a trailer is not permitted.

The laboratory shall be air conditioned. Adequate and satisfactory lighting, heating and drinking water shall be provided. The Contractor shall furnish all water, fuel, and electrical power required to conduct the various tests. The power provided shall be adequate to simultaneously operate all laboratory equipment and utilities, including an air conditioner if the laboratory is so-equipped. A table, chairs, desk, work bench, fireproof filing cabinet and telephone shall be provided in each laboratory.

In case of fire, theft or breakdown, all equipment involved shall be repaired or replaced by the Contractor within 48 hours. In the event buildings are destroyed or rendered untenable for any reason they shall be replaced within two weeks or as directed. In the interim, the Contractor shall provide temporary facilities for laboratory operations.

When both bituminous and cement concrete mixing plants are located in the same compound and when the Contractor provides one laboratory building for both bituminous and cement concrete testing facilities, duplication of laboratory equipment will not be required with the exception of the computer equipment specified in **Subsection 930.03.3**.

930.03 LABORATORY REQUIREMENTS.

930.03.1 Bituminous Concrete Mixing Plants. The Contractor shall provide the following at the bituminous mixing plant:

a. Equipment and Supplies.

1. One automatic bituminous compactor complete with hammer assembly; 4-inch, 10-pound drop hammer and counter, with automatic shutoff.

2. Four bituminous compaction molds complete with mold body, base plate and collar (4-inch inside diameter).

3. One sample splitter ½-inch chute with width - 16 chutes.

4. One sample splitter 2½-inch chute width - 8 chutes.

5. One asphalt ignition oven capable of automatically determining the corrected asphalt content of a 3,000 gram sample. The oven shall have an integral weighing system and printer capable of providing a hard copy of test results. A suitable work area and adequate ventilation for the oven's exhaust shall be provided. Two pair of heat resistant gloves (Gilson Model SE-31 or equal), two sample trays and a face shield (Gilson Model SE-42 or equal) shall be provided. The internal scale shall conform to **Subsection 930.03.4** of these Specifications. The Contractor shall perform all maintenance of the oven at intervals recommended by the manufacturer.

6. One motor-driven 12-inch sieve shaker, complete with belt driven mechanism to produce combination rocking and tapping action, capacity for 6 full-height 12-inch sieves plus pan and cover; all parts mounted on a sturdy base.

7. One gravity drying oven of rugged construction with 3/8-inch thick insulated walls, minimum inside dimensions to be 18 inches wide, 14 inches deep and 19 inches high, equipped with two expanded metal shelves, automatic thermostat and other controls, a glass thermometer reading 0° to 300°C by 1^{O} divisions.

8. One set of US Standard 12-inch round intermediate height testing sieves with stainless steel mesh. Sizes shall include 1½", 1¼", 1", 3/4", ½", 3/8", Nos. 4, 8, 16, 30, 50, 100, and two No. 200, with square openings, two pans and one cover.

9. Six drying pans approximately 10" x 14" x 2½" for use in the oven.

10. One digital scale - 8,000 grams plus/minus 0.1 grams.

11. Two brass wire briquette brushes.

12. Three sieve or sash brushes.

13. Two approved dial type thermometers - 50°F to 500°F.

14. One approved two-burner electric hot plate, UL approved.

15. Metal mixing bowl, 14 inches or greater diameter.

16. Sample splitting tool.

17. Two putty knives.

18. Five metal sampling buckets.

19. Dust masks.

20. Two pairs of suede work gloves.

22. An adequate supply of towels for Marshall core specific gravity test.

23. An approved cleaning solvent for the equipment must be provided.

24. Two pairs of safety goggles and two pairs of gloves for high heat applications.

25. One Marshall core specific gravity apparatus.

26. One Density tank for Marshall core specific gravity.

27. Two sampling spoons.

28. Two spatulas.

29. One shovel.

30. One fire extinguisher (10 lbs. min.).

31. A hood with an exhaust fan or other acceptable means of ventilation.

32. First Aid Kit.

930.03.2 Cement Concrete Mixing Plants. The Contractor shall provide the following at the concrete mixing plant:

a. Equipment and Supplies.

1. One digital platform beam scale, capacity 45 kilograms, sensitivity 5 grams.

2. One approved two-burner electric hot plate, UL approved.

3. One gravity drying oven of rugged construction with 3/8-inch thick insulated walls, minimum inside dimensions to be 18 inches wide, 14 inches deep and 19 inches high, equipped with two expanded metal shelves, automatic thermostat and other controls, a glass thermometer reading 0° to 300° C. by 1^{O} divisions.

4. One Gilson type sieve shaker (Model TS-1) with timer or equivalent, consisting of eight changeable screens; screens to be within US Standard tolerances and have openings as follows: 2½", 2", 1½", 1", 3/4", ½", 3/8", No. 4, No. 8, No. 16, and pan. The unit should be enclosed and adequate ventilation shall be provided.

5. One motor-driven portable sieve shaker for operation on 110-volt, 60-cycle single phase current, complete with belt driven mechanism to produce combination rocking and tapping action, capacity for 6 full-height sieves plus pan and cover; all parts mounted on a sturdy base.

6. One set of brass-frame United States Standard testing sieves, all to be full height, 8 inches in diameter and matched for nesting; one each of the following: 3/4", ½", 3/8", Nos. 4, 8, 16, 20, 30, 40, 50, 80, two No. 100, and one No. 200 mesh with No. 14 mesh backing, two pans and one cover.

7. Three fine, 2-inch sieve or sash brushes and two brass wire briquette brushes.

8. One set of 8 sturdy pans for drying soils, approximately 10" x 14" x 2¼" of 12-gauge metal.

9. One complete air meter test outfit, 1/4 cubic foot, (Ref. AASHTO T152 and ASTM C231).

10. One complete slump test outfit (Ref. AASHTO T23 and T119).

11. One sturdy pan, 14-gauge metal, with reinforced rims 24" x 24" x 3".

12. One sample splitter ½-inch chute width - 16 chutes.

13. One sample splitter 2½-inch chute width - 8 chutes.

14. One digital scale - 2,000 grams plus/minus 0.1 gram.

15. One small concrete scoop (#1).

16. Two dial thermometers (0°F to $+160^{O}$F).

17. Four plastic buckets, 5-gallon capacity.

18. One fire extinguisher (10 lbs. min.).

19. One shovel.

20. One steel brush, long handle.

21. Two putty knives.

22. Two pairs of suede work gloves.

23. One square steel trowel (6-inch length center handle).

24. First-Aid Kit.

25. One plastic storage tote (10-gallon capacity, 24" x 16" x 8.75" minimum).

26. One large concrete scoop (#2).

930.03.3 Computer Equipment. The items of computer equipment and software to be furnished, installed, tested, made operational, and maintained within the Plant Field Laboratory are set forth in Special Provision Code 930.1000. If a plant is producing both asphalt and concrete, two complete sets of computer equipment will be required.

Should the Contractor fail to provide any of the supplies or equipment described above and deemed necessary by the Engineer, the State will not accept any mixes or products dispatched from subject site unless otherwise approved by the Engineer.

930.03.4 Scales. All scales for bituminous and cement concrete mixing plant testing equipment must be calibrated every six months and must conform to the requirements of applicable Specifications.

930.03.5 Catalogues. Catalogs for the above equipment are available at the Department's Materials Laboratory.

930.04 METHOD OF MEASUREMENT. Not applicable.

930.05 BASIS OF PAYMENT. Provision of "Plant Field Laboratory" will not be paid for separately, but shall be considered a subsidiary obligation of the Contractor, with the costs thereof distributed among the contract unit prices for other items of work.

SECTION 931

CLEANING AND SWEEPING PAVEMENT

931.01 DESCRIPTION. This work consists of cleaning and sweeping surfaces of bituminous concrete pavement and cement concrete pavement designated on the Plans or as directed by the Engineer to remove materials deposited on said pavements during extended delays in construction operations, all in accordance with these Specifications. These delays include, but are not limited to, suspension of construction operations during the winter months and the interruption of construction operations for extended lengths of time between the placement of successive courses of bituminous concrete pavement. Two items of work are covered by this Section.

931.01.1 Cleaning and Sweeping Pavement. This work consists of cleaning and sweeping the entire roadway surface and/or gutter area. The sweepings must be removed prior to the placement of any successive pavement.

931.01.2 Cleaning and Sweeping Pavement for Statewide Striping Contracts. The work consists of cleaning and sweeping limited areas of roadway surface for the sole purpose of preparing said pavement to receive striping and markings. The work shall be performed simultaneously with, and in advance of the striping operation. All sweeping operations will be performed at the discretion of the Engineer.

931.02 MATERIALS. Not applicable.

931.03 CONSTRUCTION METHODS. All sands, silts, gravels, vegetation, and debris of every description shall be removed from the designated areas by approved mechanical or manual sweeping methods. All such material shall be removed to the complete satisfaction of the Engineer prior to either resurfacing, placing wearing surface courses, or placement of striping and markings, as the case may be.

931.03.1 Disposal of Collected Debris. The legal disposal of all collected material shall be accomplished as follows.

a. Street Sweepings. This debris includes sand that may be mixed with salt used on streets, roads, highways for winter storm operation.

1. Acceptable Uses. Street sweepings may be reused in the following ways:

(a) Landfill Cover (may require screening).

(b) Road Base, or any base course application that will be covered with an asphalt or concrete layer.

(c) Backfill for public works construction projects other than areas adjacent to concrete pipes and structures.

(d) Clean fill, only when analytical testing for Total Petroleum Hydrocarbons (TPH), Toxicity Characteristic Leaching Procedure (TCLP), and Total Lead (TL) have been performed and submitted to RIDEM, Division of Waste Management, for review of reuse application.

2. Unacceptable Uses. Street sweepings may not be used as unrestricted clean fill in areas that will expose the debris to human contact such as:

(a) Fill on residential properties, public parks or playgrounds.

(b) Fill near pristine waterways, drinking water watersheds, wellhead protection areas, areas with groundwater classified as GAA, and areas within 200 feet of a private drinking water well, or in any other manner that would be inconsistent with State and Federal laws or regulations.

b. Other Debris. All other debris collected from the roadway surface shall be legally disposed of.

931.04 METHOD OF MEASUREMENT.

931.04.1 Cleaning and Sweeping Pavement. "Cleaning and Sweeping Pavement" will be measured by the area in hundred square yards of those bituminous concrete surfaces and cement concrete surfaces actually so-treated in accordance with the Plans and/or as directed by the Engineer.

931.04.2 Cleaning and Sweeping Pavement for Statewide Striping Contracts. "Cleaning and Sweeping Pavement for Statewide Striping Contracts" will be measured by the number of days the sweeper is actually employed in the construction work in accordance with the Plans and/or as directed by the Engineer. The minimum width to be cleaned and swept under this item shall be no less than 6 feet.

931.05 BASIS OF PAYMENT.

931.05.1 Cleaning and Sweeping Pavement. The accepted quantity of "Cleaning and Sweeping Pavement" will be paid for at the contract unit price per hundred square yards as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, equipment and materials, including legal disposal of the sweepings, and all other incidentals required to finish the work, complete and accepted by the Engineer.

931.05.2 Cleaning and Sweeping Pavement for Statewide Striping Contracts. The accepted quantity of "Cleaning and Sweeping Pavement for Statewide Striping Contracts" will be paid for at the contract unit price per day as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, equipment, and materials, including legal disposal of the sweepings, and all other incidentals required to finish the work, complete and accepted by the Engineer.

Payment for cleaning and sweeping pavements to remove materials deposited thereon during normal, uninterrupted construction operations is paid for under **SECTION 401; DENSE GRADED BITUMINOUS CONCRETE PAVEMENTS**, of these Specifications.

SECTION 932

CUTTING AND MATCHING PAVEMENT

932.01 DESCRIPTION. This work consists of cutting back and matching cuts in both Portland cement and bituminous concrete pavements to the required depths of the specified course, or courses, at the locations indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

932.01.1 Cold Joints. This work also includes the installation of cold joints if such joints occur during paving operations.

932.02 MATERIALS. Not applicable.

932.03 CONSTRUCTION METHODS. The method of cutting shall be approved by the Engineer prior to the commencement of construction operations. The sections of existing pavement to be removed, surface course, base course, or combination thereof, shall be cut along the neat lines shown on the Plans or as directed by the Engineer. A vertical cut of at least 2½-inches deep shall be made along the designated lines. The pavement to be removed shall then be chipped and removed. The edge of the cut joint shall be thoroughly cleaned by sweeping and blowing with compressed air. The clean edge shall then be protected by adequate measures until the new pavement is placed and matched thereto.

Any existing pavement, surface course, base course, or combination thereof, beyond the neat lines called for on the Plans that is damaged or destroyed by the Contractor's operations shall be either repaired or replaced at no additional cost to the State.

932.03.1 Cold Joints. If, as a result of paving operations, a cold joint occurs, the Contractor will install the joints as directed by the Engineer.

932.04 METHOD OF MEASUREMENT. "Cutting and Matching Pavement" will be measured by the length in linear feet of cuts actually made on designated courses of pavement in accordance with the Plans and/or as directed by the Engineer.

932.05 BASIS OF PAYMENT. The accepted quantities of "Cutting and Matching Pavement" of the types specified will be paid for at their respective contract unit prices per linear foot as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, materials and equipment and all other incidentals required to finish the work, complete and accepted by the Engineer.

932.05.1 Cold Joints. No additional payment will be made for installation of cold joints if such joints are caused by the Contractor's sequence of paving operations.

SECTION 933

SAW CUTTING OF PAVEMENTS FOR INSTALLATION OF TRAFFIC COUNT LOOP DETECTORS

933.01 DESCRIPTION. This work consists of saw cutting a slot into existing pavement surfaces for the purpose of installing a traffic count loop detector at the locations indicated on the Plans, all in accordance with these Specifications.

933.02 MATERIALS. Not applicable.

933.03 CONSTRUCTION METHODS. Representatives of the Department will establish the location for the traffic count loop detectors. The Contractor shall then cut a slot into the existing pavement surface 7/32-inch in width and between 1½-inches and 2½-inches in depth depending upon the thickness of the final surface course. The method of saw cutting shall be approved by the Engineer prior to the start of construction operations. The cutting of the slot is the Contractor's only responsibility under this item of work.

The cutting of the slot must be made prior to the placement of the final surface course regardless of the specified thickness of that course.

Personnel from the Department will provide all labor and materials required to install the detector loop wire and to subsequently seal the cut at each location.

933.04 METHOD OF MEASUREMENT. "Saw Cutting of Pavements for Installation of Traffic Count Loop Detectors" will be measured by the length in linear feet of the slots actually cut in accordance with the Plans and/or as directed by the Engineer.

933.05 BASIS OF PAYMENT. The accepted quantity of "Saw Cutting of Pavements for Installation of Traffic Count Loop Detectors" will be paid for at the contract unit price per linear foot as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, and equipment and all other incidentals required to finish the work, complete and accepted by the Engineer.

SECTION 934

FIELD CONTROL AND CONSTRUCTION LAYOUT

934.01 DESCRIPTION. In general, the establishment of basic field control and the laying out of construction work will be performed by State forces. In certain cases, however, the State may assign these functions to the Contractor. In such cases this Section of the Standard Specifications shall apply.

The work of this Section consists of establishing on the ground the basic horizontal and vertical control for the project and subsequently, providing construction layout and reference staking for the proper control and satisfactory completion of all structures, grading, paving, drainage and all other appurtenances, all in accordance with these Specifications.

934.02 MATERIALS. All stakes used for control staking shall be of the same quality as used by the Department for this purpose. For slope limits, pavement edges, gutter lines, etc., where so-called "green" or "working" stakes are commonly used, stakes of lower quality will be acceptable.

934.03 CONSTRUCTION LAYOUT.

934.03.1 Department's Responsibility. The Department will furnish the Contractor such control points, benchmarks, and other data as may be necessary for the construction staking and layout by qualified engineering or surveying personnel.

934.03.2 Contractor's Responsibilities. The Contractor shall set construction stakes and establish all lines and grades required for the work. These stakes, duly marked and checked, shall constitute the basic horizontal and vertical field control by which and in accordance with which the Contractor shall establish other necessary controls to perform the work. All basic field control must be established prior to the start of the work.

In addition to basic field control, the staking and layout of all elements of the work shall be the responsibility of the Contractor.

a. Minimum Requirements. The following shall apply:

1. Require a meeting between the Contractor and the Department's Survey Section to discuss the Department's surveying procedures and to coordinate its work with the Survey Section.

2. Provision of fully-equipped survey parties.

3. Party chiefs shall be Rhode Island Registered Land Surveyors.

4. Survey work shall be performed in accordance with procedures of the Survey Section.

5. All records shall be kept in standard Survey Section field books.

6. Survey work shall be monitored by the Survey Section.

7. “Party-day” will be defined as an eight (8) hour day, starting on-site and ending on-site.

b. Other Responsibilities.

The Contractor shall establish and protect adequate ties to all control points such that they may be conveniently re-established if disturbed or destroyed.

All stakes, references and batter-boards, including original, additional or replacement thereof, which may be required for the construction operations shall be furnished, set and properly referenced by the Contractor. The Contractor shall be solely and completely responsible for the accuracy of the line and grade of all features of the work. Any errors or apparent discrepancies found in previous surveys, plans, specifications, or special provisions shall be called to the Engineer's attention by the Contractor for correction or interpretation prior to proceeding with the work.

Upon request of the Engineer, the Contractor shall furnish copies of all data used in setting and referencing all stakes and other layout markings used by the Contractor.

When requested by the Engineer, the Contractor shall provide safe facilities for convenient access by Department forces to control points, batter-boards and references.

The Department may check the control of the work as established by the Contractor at any time as the work progresses. The Contractor will be informed of the results of these checks. However, by so doing so, the Department in no way relieves the Contractor of its responsibility for the accuracy of the layout work. The Contractor shall, at its expense, correct or replace any deficient layout and construction work which may be the result of inaccuracies in its staking operations, or of its failure to report inaccuracies found in work performed by the Department or by others. If, as a result of these inaccuracies, the Department is required to perform further studies or redesign, or both, all expenses associated therewith shall be deducted from monies due the Contractor.

934.04 METHOD OF MEASUREMENT. The establishment of field control and the layout of construction work shall be accomplished by a qualified field survey party. The number of personnel on the party, one of which will be the party chief as described above, will be sufficient to perform the day's required work. The "Survey Party" will be measured by the number of days (party-days as defined above) the party is actually engaged in the work in accordance with the provisions of the Contract and/or as directed by the Engineer.

Calculation of "Survey Party" days will be computed by dividing the number of actual hours worked on site by eight hours.

The Contractor shall make every effort to schedule survey time such that no less than four hours of survey work is completed on any particular day. In no case will compensation be made for any work of less than four hours duration.

Off-site work including, but not limited to, calculations, sketches, drawings, tabulations, correspondence, and/or research will be considered as incidental to the work described above, and will not be considered for payment.

934.05 BASIS OF PAYMENT. The approved number of "Survey Party" days will be paid for at the respective party-day rate as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, and equipment, including transportation of crews, surveying supplies, and all other incidentals required to finish the work, complete and accepted by the Engineer.

If this item is not specified for payment in the Proposal, the Department will assume responsibility for its performance under the provisions of **Subsection 105.08; Construction Stakes, Lines and Grades** of these Specifications.

SECTION 935

REMOVING BITUMINOUS PAVEMENT BY COLD PLANING

935.01 DESCRIPTION. This work consists of the removal of bituminous material using cold planing or grinding methods to a depth as specified on the Plans, all in accordance with these Specifications.

935.02 MATERIALS. Not applicable.

935.03 CONSTRUCTION METHODS.

935.03.1 Equipment. The equipment for removing the bituminous pavement shall be a power operated planing machine or grinder capable of removing a layer of bituminous material. The equipment shall be capable of accurately establishing profile grades by referencing from either the existing pavement or from an independent grade control, and shall have a positive means for removing excess material from the surface and preventing any dust resulting from the operation from escaping into the air. A 30-foot ski shall be utilized with the pavement removal equipment on all limited-access highways and on other types of highways when indicated in the Contract Documents.

The equipment furnished by the Contractor shall be in good repair and shall be maintained so as to produce a clean cut to the pavement at all times.

935.03.2 Cold Planing. The planed surface shall conform generally to the grade and cross slope required and be free from being torn, gouged, shoved, broken or excessively grooved. The surface shall be free of imperfections of workmanship that will prevent the surface from being resurfaced with new pavement following this operation. Surface texture shall be rough grooved or as specified by the Engineer, and in all cases shall be acceptable to traffic in the event resurfacing is delayed.

No asphalt cuttings shall remain on the project at the end of each work day. Asphalt cuttings shall be removed and legally disposed of by the Contractor.

Care shall be exercised in planing adjacent to roadway joints, roadway appurtenances and face of curbing.

935.04 METHOD OF MEASUREMENT. "Removing Bituminous Pavement by Cold Planing" will be measured by the number of square yards of said pavement actually removed in accordance with the Plans and/or as directed by the Engineer.

935.05 BASIS OF PAYMENT. The accepted quantity of "Removing Bituminous Pavement by Cold Planing" will be paid for at the contract unit price per square yard as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials and equipment, and all other incidentals required to finish the work complete and accepted by the Engineer.

SECTION 936

MOBILIZATION

936.01 DESCRIPTION. This work consists of those efforts necessary for the movement of the Contractor's personnel and equipment to the project site and for the establishment of all the Contractor's field offices, buildings and other facilities required for the performance of the Contract.

936.02 MATERIALS. Not applicable.

936.03 CONSTRUCTION METHODS. Not applicable.

936.04 METHOD OF MEASUREMENT. This work will be measured for payments as follows:

a. First Payment. The first payment of 50 percent of the lump sum bid price for Mobilization or 5 percent of the total contract amount without mobilization, whichever is the lesser, will be made on the first progress payment.

b. Second Payment. The second payment of 35 percent of the lump sum price for Mobilization or 3.5 percent of the total contract amount without mobilization, whichever is the lesser, will be made when the progress payment estimate of the amount earned, not including that amount earned for mobilization, is 5 percent of the total contract amount without mobilization.

c. Third Payment. The third payment of 15 percent of the lump sum price for Mobilization or 1.5 percent of the total contract amount without mobilization, whichever is the lesser, will be made when the progress payment estimate of the amount earned, not including that amount earned for mobilization, is 10 percent of the total contract amount without mobilization.

d. Final Payment. Upon completion of all the work on the project, including demobilization, payment of any amount bid for Mobilization in excess of the total amount previously paid, will be paid.

936.05 BASIS OF PAYMENT. "Mobilization and Demobilization" will be paid for at the contract lump sum price as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials and equipment and other incidentals required to establish

the Contractor's facilities at the site and, at the conclusion of the contract, for the complete removal thereof.

No lump sum breakdown will be required for this item of work.

SECTION 937

MAINTENANCE AND MOVEMENT OF TRAFFIC PROTECTIVE DEVICES

937.01 DESCRIPTION. This work consists of removing (from original locations), maintaining, storing, covering and uncovering, relocating and re-erecting all temporary construction signs, sign mountings, portable barricades, traffic cones, delineators and other traffic warning devices when so-directed by the Engineer, all in accordance with this Specification. All such maintenance and movement work on these devices shall take place after their initial installation on the project and prior to their final removal from same.

937.02 MATERIALS. Not applicable.

937.03 CONSTRUCTION METHODS.

937.03.1 Normal Operations. The Contractor shall maintain all signs, barricades and other protective devices in a sturdy, clean, and legible condition. In this regard "maintenance" involves the following: repairing; adjusting; washing; repainting; and the re-application of reflective sheeting.

The various devices shall be located in their proper positions such that they reflect existing traffic conditions. As conditions change, signs and devices shall be removed and covered so that the respective messages are not visible to approaching traffic. Where changed conditions warrant, new devices will be provided. When construction operations are not in progress, all unnecessary signs shall be appropriately covered.

Care shall be exercised such that weeds, shrubbery, and construction materials, equipment, and spoils do not obscure the message of any sign, light, or barricade.

No defective and/or damaged devices shall be installed. Devices showing defects or damages caused as a result of the Contractor's operations or negligence shall be either repaired or removed and replaced at no additional cost to the State. When the Engineer determines that a sign or device requires replacement due to normal wear and tear, or that said sign or device has been severely damaged by causes other than the Contractor's operations, these signs and devices shall be replaced and paid for in accordance with the provisions of those Sections of these Specifications that apply to the particular devices in question.

937.03.2 Emergencies. At the preconstruction conference the Contractor shall provide the Department with both the home telephone and beeper numbers of at least three personnel who will be available on a 24-hour basis for the duration of the Contract. These persons shall constitute the "contacts" in the event of an emergency.

Upon notification by the Engineer, the Contractor, through its contact personnel, will respond to the site of an emergency within ninety minutes and immediately take steps to commence repair operations.

937.04 METHOD OF MEASUREMENT. This work does not require a measurement for payment.

937.05 BASIS OF PAYMENT.

937.05.1 Payment for Full Compliance. "Maintenance and Movement of Traffic Protective Devices" will be paid for at the contract lump sum price as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, and equipment, including removing the devices from their initial locations, handling, maintaining, transporting and relocating said devices to storage or to subsequent intermediate locations at which they are to be used for traffic control, and all other incidentals required to finish the work, complete and accepted by the Engineer.

Monthly progress payments under this item will be made at a rate determined by dividing the contract lump sum price by the number of months allocated for completion of the contract. Said number of months shall be equal to the difference between the contract completion date and the date of the Notice to Proceed.

Payment for authorized contract time extensions will be made at the calculated monthly rate as defined above.

If the contract is completed prior to the authorized completion date, the final monthly payment will consist of the remaining balance of the contract lump sum price.

No payment will be made for unauthorized contract time extensions.

937.05.2 Failure to Comply. If, in the judgement of the Engineer, the Contractor fails to adequately and safely maintain traffic control devices along any portion of the project, or, if the Contractor fails to move and/or relocate traffic control devices to meet changes in traffic conditions, construction operations, or conditions affecting the safety of the public, the following liquidated damages and penalty will be assessed.

a. For each day the Engineer determines that the Contractor has failed to comply with the provisions of this Section, the daily charge set forth in **Special Provision Code 937.1000** will be deducted from monies then due the Contractor.

b. In addition, for any month that the Engineer determines that the Contractor has failed to comply with the provisions of this Section, the monthly progress payment for said month shall be reduced by an amount equal to the ratio of the number of days the Contractor was not in compliance with the provisions of this Section to the total number of days in the month in question times said regular monthly progress payment.

937.05.3 Emergencies. In the event that emergency repair work has not been initiated within the ninety-minute time frame specified above, the sum of three times the daily charge set forth

in Special Provision Code 937.1000 will be deducted from monies then due the Contractor for each day until said repair work is undertaken.

a. Repair Work by Others. If emergency repair work is performed by a party other than the Contractor or one of its first-tier subcontractors, and if the other party is not compensated for its work within 60 days following completion of the repair work, the Engineer reserves the right to withhold monies then due the Contractor in order to provide payment to the other party.

SECTION 938

PRICE ADJUSTMENTS

938.01 DESCRIPTION. The intent of this provision is to insure adequate and fair compensation for unpredictable and fluctuating costs which, from time to time, occur in the prices of Liquid Asphalt and Diesel Fuel. The price adjustment provisions are made part of the Contract to assure more realistic bidding and encourage competition.

938.02 DEFINITIONS.

938.02.1 Base Price. The base price is the unit price of the material (FOB Terminal), as determined by the Department, just prior to the first date that the NOTICE TO CONTRACTORS is advertised in the public press.

938.02.2 Period Price. The period price is the unit price of the material (FOB Terminal), as determined by the Department, for any one month period following the NOTICE TO PROCEED during which the price varies from the base price.

938.03 PRICE ADJUSTMENT. Price adjustment will be determined by the difference between the Period Price and the Base Price. Price adjustments will be made at the end of each month during which a); work was accomplished on the project and b); prices varied. Price adjustments will not be allowed beyond the completion date of the Contract or an approved extension thereof.

Price adjustments will be made in accordance with an approved Contract Addendum.

938.03.1 Liquid Asphalt Cement. The asphalt content will be the optimum amount used in every ton of bituminous concrete mixture, as determined by the Department's Materials Engineer, using the method for determination of optimum asphalt cement content as set forth in **SECTION M.03** of these Specifications.

The Price Adjustment will be determined by multiplying the total weight of liquid asphalt, in tons, by the difference between the base price and period price.

The Base Price of Liquid Asphalt Cement is set forth in **Special Provision Code 938.1000**.

938.03.2 Diesel Fuel. The fuel for operating the plant, and the fuel for hauling and placing bituminous concrete, will equal the total number of tons of bituminous concrete placed during the month in question times a fuel adjustment factor of 2.5 gallons of fuel per ton of bituminous concrete. Tonnage of bituminous concrete placed during the month in question will equal the sum of the weights indicated on the Daily Automated Recordation printout slips provided at the plant.

The Price Adjustment will be determined by multiplying the total volume of fuel, in gallons, by the difference between the base price and the period price.

No price adjustment will be made unless the amount of the adjustment, plus or minus, exceeds $250.00 for the month.

The Base Price of Diesel Fuel is set forth in **Special Provision Code 938.1000**.

SECTION 939

STONE WALLS IN HISTORIC, SCENIC OR RURAL AREAS

939.01 DESCRIPTION. This work consists of the resetting and construction of stone walls in historic, scenic, or rural areas. Such walls require special treatment as indicated herein, and shall be constructed at locations indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

939.02 MATERIALS.

939.02.1 Stones. Stones for walls to be reset shall include stones in the existing wall, with additional stones as required to complete the wall construction. Additional stones shall conform to the stones in the existing wall relative to shape, color, texture and geological composition. Stones for new walls shall conform to stones found in nearby walls relative to the aforementioned characteristics, unless otherwise noted on the Plans or directed by the Engineer.

Stones used below grade, for the core, or for the back of a retaining wall need not meet these criteria. However, the stones must conform to **SECTION M.14; STONE FOR MASONRY**, of these Specifications, and must be appropriately sized and shaped to permit proper interlocking with the existing stones.

Any special features such as lintels, gate posts, copings, markers, etc., shall be retained for resetting.

939.02.2 Mortar. Mortar shall conform to the requirements of **Subsection M.04.03.5; Mortar**, of these Specifications.

939.03 CONSTRUCTION METHODS.

939.03.1 General Requirements. The construction of new walls or the resetting of existing walls will be carried out as indicated on the Plans. Laying of stones shall conform to the requirements of **Subsections 911.03 and 912.03** of these Specifications for wet masonry walls and dry-laid walls, respectively.

The construction of walls in historic areas must be accomplished by stone masons with demonstrated proficiency in historic stone masonry construction/restoration practices. Documentation in the form of professional certifications and the locations of at least three successfully completed stone walls similar in type to the work to be performed must be presented to the Engineer no less than 30 days prior to the start of work. This documentation must be approved by the Engineer in consultation with the RIDOT Historic Preservation Specialist in order for the masonry contractor to be allowed to perform the work. The approved mason(s) are to complete the entire work item for which the approval was given.

939.03.2 Documentation. Prior to dismantling historically significant walls, the Contractor will measure and record their width and height at 25-foot intervals and at locations where characteristics of the wall change. He must also take a minimum of six, 35mm, 4-inch by 6-inch color photographs of each wall to be dismantled. The photographs are to be taken in locations that are representative of the walls original type. If no representative wall sections exist, the Engineer in consultation with the RIDOT Historic Preservation Specialist will determine the finished appearance/dimensions. Two copies of the measurements and two sets of photographs are to be given to the Engineer. This documentation must be reviewed and approved by the Engineer in consultation with the RIDOT Historic Preservation Specialist for accuracy before the walls are dismantled. Once approved, this record of the walls will be referenced during the reconstruction of the walls and will remain the property of the State.

939.03.3 Dismantling. Historically significant walls to be removed and reset must be carefully dismantled to avoid fracturing and chipping the stones. The stones shall be stockpiled in the area where the wall is to be rebuilt. If they must be temporarily moved to a different location, they must be kept separate from any other stones. Use of a dump truck will not be permitted to transport stone from historically significant walls. The Contractor will be responsible for protecting all stockpiled stones from damage, theft and vandalism.

939.03.4 Resetting. Exposed face(s) must be composed of stones from the extant walls. Care shall be taken during resetting to keep weathered stone faces exposed. Additional stones required to complete the walls are to be blended with the existing stone in order to reduce any incompatibility in the appearance of the walls. The Contractor shall carefully duplicate the original wall and any special features such as lintels, gateposts, openings, copings, markers, etc.

939.03.5 New Walls. When new stone walls are required in the vicinity of historic properties and districts, a 5-foot long sample section of wall must be constructed. The Engineer in consultation with the RIDOT Historic Preservation Specialist is to approve stone, joint construction and overall character of installation of the sample section. The approved sample section may be part of the finished work. A rejected sample section must be demolished and rebuilt to the approval of the Engineer.

939.0376 Weep Holes. Weep holes shall be constructed of solid, gray PVC pipe in the manner and at the locations indicated on the Plans or required by the Engineer.

939.03.7 Cleaning. All excess material shall be removed and the site left in a presentable condition, satisfactory to the Engineer. If surplus stones exist, the Engineer will determine whether to transport the surplus stones to an offsite, permanent stockpile area, or to dispose of the material.

939.04 METHOD OF MEASUREMENT. "Stone Walls in Historic, Scenic or Rural Areas" will be measured either by the number of linear feet (measured along the centerline of the wall) or the number of cubic yards of masonry, as applicable, actually placed in accordance with the Plans, these Specifications and/or as directed by the Engineer.

939.05 BASIS OF PAYMENT. The accepted quantity of "Stone Walls in Historic, Scenic or Rural Areas" will be paid for either at the contract unit price per linear foot (measured along the centerline of the wall) or by the contract unit price per cubic yard of masonry, as listed in the Proposal. The price so-stated constitutes full compensation for all labor, materials, and equipment, including documenting and dismantling of the existing wall, stockpiling of stone, removal of stones from the stockpile, all necessary cutting/dressing of stones, reconstruction of special features, construction of weep holes, cleaning, and all other incidentals required to finish the work, complete in place and accepted by the Engineer.

Special site preparation such as clearing and grubbing or gravel base courses will be paid for under other appropriate Proposal items of the Contract.

Removal and stockpiling of surplus stone at an offsite, permanent stockpile location will be paid for under an appropriate Proposal item in the Contract.

Stones required to construct new walls or to supplement quantities of stones in existing walls will be paid for under separate Proposal item(s) in the Contract.

SECTION 940

ON-SITE ADMINISTRATION FACILITY

940.01 DESCRIPTION. This work consists of providing and maintaining a suitable weatherproof unit on the project site to be used for the on-site administration of the Contract. The facility will not be for the exclusive use of the State, but will be for administration activities only.

940.02 GENERAL REQUIREMENTS.

940.02.1 Minimum Spatial Requirements. Unless specified otherwise in the Special Provisions of the Contract, the facility shall contain a minimum of 128 square feet of floor area and 7 feet of headroom. It shall have suitably located windows (two vented and one fixed) to provide at least 20 square feet of natural light, and one exterior entrance door. A commercial office trailer, 16 feet by 8 feet, is considered to satisfy the above requirements.

940.02.2 Other Requirements.

a. In the event of loss or damage resulting from vandalism or weather, repairs to the facility will be completed within 48 hours. If the facility is destroyed or rendered untenable for any reason, it shall be replaced within 2 weeks or as directed by the Engineer.

b. The timely provision of the on-site administration facility, as specified, shall be mandatory consideration for initial payments with proper maintenance of the facility being mandatory consideration for future progress payments to the Contractor for any and all work performed.

c. The Contractor shall maintain this facility and its equipment on the project site until the project has been determined to be "substantially complete."

940.03 SPECIFIC REQUIREMENTS. The On-Site Administration Facility shall be provided for as follows:

a. Equipment and Facilities.

1. 115-volt, 60-cycle, 60-amp electrical current, sufficient for lighting and equipment operation.

2. Lighting will be overhead, consisting of 2 twin tube flourescent fixtures, each 48 inches in length with cold-start ballasts.

3. Adequate toilet facilities with supplies. Facility may be a port-a-john type external unit located in close proximity to the administration facility.

4. All windows shall have screens as applicable, clear glass and be properly shaded. Each door shall have key-in-knob, or equivalent, of an approved manufacturer, and all doors shall be keyed alike.

5. A 5-pound C02 fire extinguisher.

6. A work or plan table, built in, will be provided at each end of the facility.

7. One telephone, for local calls only.

8. First Aid Kit.

9. Electric sanitary water cooler with bottled drinking water and cups.

10. Three chairs suitable for use with the provided built-in tables.

940.04 METHOD OF MEASUREMENT. Not applicable.

940.05 BASIS OF PAYMENT. Provision of the On-site Administration Facility together with all associated costs of equipment, telephone, telephone lines, drinking water, toilet facilities,

electricity, and other associated services and supplies will not be paid for separately, but shall be considered a subsidiary obligation of the Contractor, with the costs thereof distributed among the contract unit prices for other items of work.

SECTION 941

REPLACEMENT OF PARTIALLY DAMAGED SAFETY RELATED HARDWARE

941.01 DESCRIPTION. This item provides a method of payment for the replacement of partially damaged or vandalized safety related hardware following partial acceptance of the work. Safety related hardware includes, but is not necessarily limited to, crash cushions, breakaway signs and luminaries and their corresponding supports, delineators, guardrail and appurtenances, bridge railing and concrete median barriers.

941.02 MATERIALS. Materials shall conform to the applicable requirements of these Specifications for the items involved.

941.03 CONSTRUCTION METHODS. Construction methods shall conform to the applicable requirements of these Specifications for the items involved.

941.04 MEASUREMENT AND PAYMENT. "Replacement of Partially Damaged Safety Related Hardware" will be paid for at the applicable contract unit price as listed in the Proposal for the partially damaged work minus a credit for any undamaged components of the partially damaged work. The credit for undamaged components shall be verified by the Contractor's presentation of its original paid receipts or bills of lading for the undamaged components.

SECTION 942

DETECTABLE WARNING SYSTEMS

942.01 DESCRIPTION. This work consists of providing and installing a polyurethane mat with truncated domes in an offset pattern that is compliant with Americans with Disabilities Act (ADA) warning and directional systems for the visually impaired at locations indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

942.02 MATERIALS. The detectable warning mat shall be of dimension and color within ADA standards and the discretion of the Engineer. Adhesive, seam sealer and edge sealer shall conform to the specifications of the mat manufacturer and shall be acceptable to the Engineer. Nylon anchors shall conform to the dimension and sizes indicated on the detail and shall be acceptable to the Engineer.

942.03 CONSTRUCTION METHODS.

942.03.1 Surface Preparation. The concrete surface should be relatively flat, smooth and dry. Fresh concrete requires a full 21-day cure prior to mat installation. Any cracks or holes larger than 1/8-inch need to be patched prior to applying ground adhesive. The installation area should be prepared by using a wire brush to remove paint, gum and other unwanted materials from the surface and sweeping the area to remove all dirt and dust.

942.03.2 Mat Placement. Place mats in the desired location. If mats need to be cut or shaped, make the necessary cuts with a saw or knife and fit each mat into place. Once all mats are in position, apply a 2-inch wide strip of duct tape around the entire outer perimeter making sure that the tape does not overlap onto the mats, as this will leave an area without glue when the mats are installed.

942.03.3 Adhesive Application. Following the manufacturer's directions, thoroughly mix equal amounts of Part A and Part B of the ground adhesive in an oversize container. Apply the adhesive to the entire area inside the taped perimeter using a 3/32-inch notched trowel (approximately 10 mil thickness). Be certain that all edges and corners have adequate coverage of the ground adhesive. Allow the adhesive to become tacky to the touch, normally about 40 minutes (see directions on container). Do not allow the adhesive to dry completely.

942.03.4 Mat Installation. Place mats one at a time in their pre-laid positions. Take care to position them tightly against each other, using the tape edge as a guide. Press firmly from the center to the outer edges to remove any air bubbles that may have formed. Press on the areas between the domes in order to remove all air that may have accumulated under the mats. When joining mats together, spot tack the edges together as tightly as possible using drops of seam sealer. When the mats are in position, carefully remove the tape from the perimeter. Press down the edges and corners of each mat firmly.

942.03.5 Seam Sealer. Apply a small bead of Seam Seal Adhesive along all joint seams.

942.03.6 Edge Sealer. Apply a small bead of edge sealer along all outer edges.

942.03.7 Anchor Installation. After the mats have been completely installed and the ground adhesive has set, the nylon anchors can be installed. Using a 1/4-inch masonry bit, drill holes through the mats and at least 1 inch into the concrete. Place 1/4" x 1" nylon anchors in the holes and tap them in with a hammer. Do not place anchors in the domes. Anchor placement shall be according to the manufacturer's recommendations.

942.04 METHOD OF MEASUREMENT. "Detectable Warning Systems" will be measured by the number of square feet of polyurethane mat actually installed in accordance with the Plans and/or as directed by the Engineer.

942.05 BASIS OF PAYMENT. The accepted quantities of "Detectable Warning Systems" will be paid for at the contract unit price per square foot as listed in the Proposal. The price so-stated shall constitute full and complete compensation for all labor, materials, equipment, and other incidentals required to finish the work, complete and accepted by the Engineer.

PART T

TRAFFIC CONTROL SYSTEMS

SECTION T.01

ELECTRICAL WORK

T.01.01 DESCRIPTION. This work consists of performing electrical work common to, but not necessarily limited to, the installation of traffic signals, highway lighting and illuminated signs at the locations indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications, the National Electric Code, the National Electric Safety Code, and the electrical utility company.

The work includes all material, labor, equipment, and incidentals necessary to provide lighting systems, traffic signal systems and cable systems for police and fire alarm, complete in every respect, and ready for use as specified. The work includes excavation, backfill, conduit and appurtenances, whether encased in concrete, attached to structures or buried in the ground.

Wherever reference is made to the code of standards mentioned herein, the reference will be construed to mean the code or standard that is in effect on the date of advertisement for bids.

All workmanship will be first class and in accordance with the highest standards of the electrical industry.

T.01.02 MATERIALS. Rigid steel conduits, handholes, pull boxes, manholes, wire and cable shall conform to the requirements specified in **SECTION M.15; TRAFFIC CONTROL SYSTEMS**, of these Specifications.

Only materials listed and tested by nationally recognized laboratories, and so labeled or identified, will be considered for acceptance for the services indicated. All materials shall be new, and all electrical equipment shall bear the manufacturer's name, trademark, or other descriptive marking by which the organization responsible for the product may be identified. Other markings shall be provided giving voltage, current, wattage, or other ratings as are prescribed elsewhere in these requirements. Electrical equipment shall be designed, manufactured, tested and rated in accordance with ANSI and the National Electrical Manufacturer's Association. All markings shall be of a durability that will withstand the environment involved, as determined by the Engineer. Where two or more items of the class of equipment are required, these units shall be the products of the same manufacturer.

All materials shall be approved by the Engineer before installation.

T.01.03 CONSTRUCTION METHODS.

T.01.03.1 Foundations. Foundations for mast arm and span poles, lighting standards, pedestal poles, service pedestals, controller cabinets, ground mounted and overhead sign structures, and other equipment shall be constructed of Class A(AE) air entrained concrete for cast-in-place units and Class XX(AE) for precast units, all conforming to the requirements specified in **SECTION 601; PORTLAND CEMENT CONCRETE.** Concrete for cast-in-place units shall be placed in accordance with **SECTION 808; CAST-IN-PLACE STRUCTURE CONCRETE MASONRY**, of these Specifications.

All foundations shall rest on firm ground and shall be poured monolithically. Conduits and anchor bolts shall be placed in proper position and shall be held in place by means of a template until the concrete sets. Forms shall not be removed until the concrete has hardened properly and not less than 24 hours after the concrete has been placed. All exposed portions of foundations shall be neatly finished with a wood float. The tops of foundations shall be finished flush with the finished grade.

Aluminum surfaces to be placed in contact with Portland cement concrete shall be given a heavy coat of an alkali-resistant bituminous paint before installation. The bituminous paint used shall meet the requirements of United States Military Specification MIL-P-6883. The paint is to be applied as it is received from the manufacturer without the addition of any thinner.

T.01.03.2 Bonding and Grounding. Traffic signals, highway lighting, illuminated sign circuits, rigid steel conduits and aboveground equipment shall be effectively bonded and grounded as hereinafter specified and as shown on the Plans for the respective installations. Bonding and grounding shall conform to the requirements of the National Electric Code and the utility company.

Ground wire and grounding rods shall conform to the applicable requirements set forth in **SECTION M.15; TRAFFIC CONTROL SYSTEMS**, of these Specifications.

The Contractor shall be responsible for maintaining 25 ohm to ground resistance in all systems.

T.01.03.3 Connection with Utility Services. For electrical work the Contractor shall install conduits and electric conductors as shown on the Plans, in accordance with the requirements of the utility company and subject to its approval. The Contractor will arrange with the serving utility to complete service connections.

T.01.03.4 Testing. Upon the completion of each wiring system, and before any connection is made to operating equipment, the Contractor shall perform, in the presence of the Engineer, the following tests of each circuit to determine whether the installations are in acceptable working order:

a. Tests for continuity.

b. Tests for grounds.

c. Tests for insulation resistance from circuit wires to ground, and between circuit wires. The insulation resistance shall not be less than the value specified in the National Electric Code.

With all equipment connected to the wiring system, a functional test shall be performed by the Contractor, in the presence of the Engineer, to demonstrate that the system as a whole, and all parts thereof, function as specified or intended herein. Any defective materials or faulty or improper installation shall be permanently corrected by repairs or replacements to be made by, and at the expense of, the Contractor, to the satisfaction of the Engineer and the utility company.

Lighting circuits shall be subjected to such other tests as may be required by the utility company. It shall be the responsibility of the Contractor to ascertain what tests are required and to perform these tests in the presence of the Engineer and the utility company's representative.

The cost of testing shall be included in the prices bid for other scheduled items of work as specified in **SECTIONS T.03 through T.14**, respectively.

T.01.03.5 Painting. Signal heads, including hanger, shall be painted with two coats of federal yellow enamel, except that the interior of hoods shall be finished with two coats of flat black enamel, unless specified otherwise. Aluminum or galvanized steel fittings and parts shall not be painted unless part of an adjacent assembly is to be painted.

The cost of painting shall be included in the prices bid for other scheduled items of work as specified in **SECTIONS T.07 through T.09** and **T.11 through T.14**, respectively.

T.01.03.6 Topsoiling and Seeding. Topsoiling and seeding after excavation and backfill shall conform to the applicable requirements of **SECTIONS L.01** and **L.02**, respectively, of these Specifications.

The cost of topsoiling and seeding shall be included in the prices bid for other scheduled items of work as specified in **SECTIONS T.04 through T.14**, respectively.

T.01.03.7 Shop Drawings. The Contractor shall submit manufacturers' shop drawings, layout drawings and specifications for equipment and appurtenances for the approval of the Engineer, in accordance with **Subsection 105.02; Plans and Shop Drawings**, of these Specifications.

a. Design Computations. Design computations for mast arms and poles, span poles and lighting standards shall be complete and shall include but not be limited to the following: consideration for all parts of the structure; consideration for all possible loading combinations including wind and ice loads; and the design stresses and allowable stresses for all components which comprise the proposed structure.

All complete shop drawings and design computations shall bear the stamp of a Registered Professional Engineer. Shop drawings shall be approved prior to fabrication, and it shall be expressly understood and agreed upon that said approval does not relieve the Contractor of its responsibility for the design, fabrication and erection of the structure.

b. Equipment Lists. Within 60 days of signing the contract, the Contractor shall furnish, for the approval of the Engineer, a minimum of five copies of a listing of the controller equipment

proposed for use under the contract. The listing shall be supplemented by catalog cuts, manufacturer's specifications, and other descriptive or pictorial data sufficient to identify and explain the method of operation and construction of the proposed equipment. Upon approval, the Engineer will retain four copies and return one approved copy to the Contractor.

T.01.03.8 Existing Systems. Where existing systems are to be modified, the existing equipment and materials shall be salvaged and incorporated in the revised system, salvaged for other use by the Department, or removed and disposed of by the Contractor, as may be provided in the Plans or as specified. Material required to be salvaged shall be removed carefully and stockpiled on site at the location designated in the Contract Documents, or as directed by the Engineer. Existing equipment and materials specified for reuse, or to be reserved for the Department, which are disturbed, damaged or removed in performing the work shall be repaired or replaced with equivalent, new equipment and materials acceptable to the Engineer, at no expense to the State.

Existing systems or portions thereof may be abandoned in place only upon receipt of the written permission of the Engineer.

T.01.03.9 Lines and Grades. It shall be the responsibility of the Contractor to arrange for the furnishing of lines and grades by the Engineer as may be necessary to lay out the work correctly, all as specified in **Subsection 105.08** of these Specifications.

T.01.03.10 Excavation and Backfill. Excavation and backfill for the construction of manholes, handholes, foundations, conduits, cables and other appurtenances shall conform to the applicable requirements of **SECTION 203; STRUCTURE EXCAVATION AND BACKFILL**, of these Specifications.

T.01.03.11 Disruption of and Damage to Existing Improvements. All pavements, curbs, gutters, culverts, guardrail, sidewalks, walls, landscaping, conduit or wire, and all other existing improvements removed due to construction, damaged or injured by any reason of or resulting from the Contractor's operations, shall be replaced or reconstructed of similar materials in a manner satisfactory to the Engineer at no additional cost to the State. When placing foundations, handholes, or conduit in existing bituminous sidewalks, the entire width of sidewalk shall be replaced. In the case of concrete sidewalks, saw cuts shall be made at score lines and the entire square of concrete shall be replaced. Saw cuts shall be made at no additional cost to the State.

T.01.04 METHOD OF MEASUREMENT. "Electrical Work" will not be measured separately but will be included in the measurement of specific items such as conduit, foundations, standards and posts, luminaires, traffic signal controllers and traffic signal heads. Measurement for payment will be as specified in **SECTIONS T.04 through T.14**, respectively.

T.01.05 BASIS OF PAYMENT. "Electrical Work" will not be paid for separately but will be included in the price of specific items, as listed in the Proposal, such as conduit, foundations, standards and posts, luminaires, traffic signal controllers, wire and cable, and traffic signal heads, as specified in **SECTIONS T.04 through T.14**, respectively.

The cost of excavation and backfill for manholes, handholes, foundations, conduits, cables, and other appurtenances, shall be included in the prices bid for such structures and

appurtenances. The excavation of rock encountered in the excavation for the above mentioned structures and appurtenances will be paid for under the provisions of "Trench Excavation - Rock" as set forth in **SECTION 205; TRENCH EXCAVATION**, of these Specifications.

SECTION T.02

HIGHWAY LIGHTING

T.02.01 DESCRIPTION. This work consists of furnishing and installing highway lighting of multiple circuit type and/or modifying existing highway lighting in accordance with the dimensions and details indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications. A highway lighting installation will be composed of two systems; one underground and the other aboveground.

The underground multiple circuit installation will consist of conduits, handholes, and concrete foundations for lighting standards or service pedestals.

The aboveground multiple circuit installation will consist of lighting poles, luminaires, lamps, service pedestals, wiring, bonding, grounding and all other incidental work.

Reference is made to the following Sections which are relevant to highway lighting:

SECTION T.03; GROUND RODS AND BARE GROUND WIRE
SECTION T.04; WIRE AND CABLE
SECTION T.05; HANDHOLES, MANHOLES, AND PULL BOXES
SECTION T.06; CONDUIT
SECTION T.07; LUMINAIRES
SECTION T.08; ALUMINUM LIGHT STANDARDS AND FOUNDATIONS
SECTION T.09; SERVICE PEDESTAL

T.02.02 MATERIALS. Refer to **SECTIONS T.03 through T.09** for specifics on materials.

T.02.02.1 Warranties for Highway Lighting Installations.

a. Manufacturer's Warranties. Copies of any warranties that the Contractor receives from each manufacturer on all electrical or mechanical equipment pertinent to the complete and satisfactory operation of highway lighting installations shall be turned over to the Department at the time of acceptance at no cost to the Department. Each warranty so furnished shall indicate its expiration date, and be in effect for a period equal to the customary trade practice.

b. Contractor's Warranties. The Contractor will warranty the satisfactory in service operation of the mechanical and electrical equipment and related components for six months following the acceptance of the contract by the State. During this period it will be the Contractor's responsibility, when notified by the Engineer, to repair or replace equipment or materials necessary to insure satisfactory operation of the system, and to correct malfunctions attributable to installation deficiencies.

All workmanship, parts, tools, equipment and all appurtenances necessary to correct malfunctions attributable to installation deficiencies are to be supplied by the Contractor at his own expense. Any labor necessary to comply with the requirements of the manufacturer's and Contractor's warranties will be compensated by force account.

T.02.03 CONSTRUCTION METHODS. Refer to **SECTIONS T.03 through T.09** for specifics on construction methods.

T.02.04 METHOD OF MEASUREMENT. "Highway Lighting" will not be measured separately but will be included in the measurements of specific items such as conduit, cable, luminaires, poles, bases, handholes, etc. Refer to **SECTIONS T.04 through T.09** for specific methods of measurement.

T.02.05 BASIS OF PAYMENT. "Highway Lighting" will not be paid for separately but will be included in the price of specific items as listed in the Proposal and outlined above in **Subsection T.02.04.**

SECTION T.03

GROUND RODS AND BARE GROUND WIRE

T.03.01 DESCRIPTION. This work consists of effectively grounding rigid steel conduits, service pedestals, lighting and signal poles, illuminated sign circuits, and traffic signal controller cabinets as shown on the Plans or as directed by the Engineer, all in accordance with these Specifications and the requirements of the National Electric Code.

T.03.02 MATERIALS. Ground rods will conform to the requirements of **Subsection M.15.01** of these Specifications. Ground wire will conform to the requirements of **Subsection M.15.02.2** of these Specifications.

T.03.03 CONSTRUCTION METHODS. Equipment grounding conductors will be provided between bridge lighting standards and their respective ground rod.

Ground rods shall extend 3 inches to 6 inches above the floor of the handhole. Ground rods shall be driven to a depth such that the resistance to ground does not exceed 25 ohms. The measurement shall be measured by common industry practice in the presence of the Engineer, with the ground wire disconnected from the neutral.

In the event that after driving the rod beyond the minimum depth, the resistance still exceeds 25 ohms, additional ground rods shall be driven outside the handhole approximately 6 feet apart to a depth of 8 feet and connected in parallel with No. 6 AWG bare conductors until the resistance to ground does not exceed 25 ohms.

The bare conductors shall be then pulled into the handhole through a hole drilled in its side, 6 inches below grade, and connected to the neutral wire and the conduit system.

The conductors and the top of ground rods outside the handholes shall be placed a minimum of 6 inches below grade. Only U.L.-approved ground wire clamps shall be used to bond the conductor to the ground rod.

Ground rods shall be driven in all handholes servicing light standards, traffic signal equipment and at such other locations as specified on the Plans or as directed. If no ground rod is used in the equipment base, the Contractor shall install a ground wire from the grounding lug on the equipment ground to the nearest ground rod, at no additional cost to the State.

The Contractor shall furnish the Engineer with the results of all resistivity tests, indicating the values obtained for each installation. This report shall become a permanent project record.

T.03.04 METHOD OF MEASUREMENT. "Ground Rods" and "Bare Ground Wire" shall not be measured for payment but shall be included with the pay item with which they are associated. Additional "Ground Rods" required to reduce the resistance to ground below 25 ohms will be measured separately in accordance with these Specifications and/or as directed by the Engineer. Additional ground wire will not be paid for separately but shall be included in the cost of additional ground rods.

T.03.05 BASIS OF PAYMENT. "Ground Rods" and "Bare Ground Wire" will not be paid for separately but shall be included with the pay item with which they are associated. The accepted quantities of additional "Ground Rods" will be paid for in accordance with **Subsection 109.04; Differing Site Conditions, Change, Extra Work, and Force Account Work**, of these Specifications.

SECTION T.04

WIRE AND CABLE

T.04.01 DESCRIPTION. This work consists of furnishing and installing wire and cable of the type 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 use of material and equipment for furnishing and installing semi-permanent splice kits and completing two-way splices in handholes and manholes, as indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

T.04.02 MATERIALS. Wire and cable shall conform to **Subsection M.15.02** of these Specifications.

T.04.03 CONSTRUCTION METHODS. Splices, taps and terminations shall be made with solderless pressure connectors. Connectors shall be sufficiently large to enclose all strands of the conductors. Conductors shall be fastened securely and shall not loosen under vibration or normal strain. The splices, taps and terminations shall be taped with a rubber tape to replace the cable's insulation. The tape shall match the cable's insulation and shall have high insulation resistance and dielectric strength; shall fuse into a homogeneous mass; shall be durable and easy to apply; and shall be moisture resistant. Before application of the insulating tape the cable insulation shall be penciled to a length not less than four times the insulation thickness. After the application of the rubber insulation tape the splices, taps and terminations shall be protected with a neoprene blend sheathing tape resistant to weather, oil, acid, alkali and normal physical abuse. Finished splices, taps and terminations shall be covered with friction tape.

Wires and cables shall be handled carefully during storage. All conductors and cables shall be drawn into the conduit system without damage to covering sheath insulation or conductor. Wiring shall not be done until the raceway system has been completed. Only lubricant manufactured specifically to assist cable pulling shall be used.

Wires on poles shall be installed by a licensed electrician and/or a licensed journeyman.

Wiring installed in raceways shall have slack cable left at all pulling points.

Installation of two-way splices and semi-permanent 3-way splice kits shall be as recommended by the manufacturer, and the National Electric Code. All splices shall be in a handhole or manhole, and at no time shall a splice be located in the conduit.

The Contractor shall submit for approval the manufacturer's notarized certificates of compliance for all wire and cable.

T.04.04 METHOD OF MEASUREMENT.

T.04.04.1 Wire and Cable. "Wire" and "Cable" will be measured by the linear foot actually installed in accordance with the Plans and/or as directed by the Engineer.

Measurement shall be along the centerline of the conduit. An allowance will be made for 5 feet of slacked cables in handholes.

T.04.04.2 Two-Way Splice. "Two-Way Splices" will be measured by the number of units actually installed in accordance with the Plans and/or as directed by the Engineer.

T.04.04.3 Semi-Permanent 3-Way Splice Kits. "Semi-Permanent Splice Kit" will be measured by the number of units actually installed in accordance with the Plans and/or as directed by the Engineer.

T.04.05 BASIS OF PAYMENT.

T.04.05.1 Wire and Cable. The accepted quantities of "Wire" and "Cable" will be paid for at their respective contract unit prices per linear foot of the various types as listed in the Proposal. The

prices so-stated constitute full and complete compensation for all materials, equipment, tools, labor and all other incidentals required to finish the work, complete in place and accepted by the Engineer.

T.04.05.2 Two-Way Splice. The accepted quantities of "Two-Way Splice" will be paid for at the contract unit price per each as listed in the Proposal. The price so-stated constitutes full and complete compensation for furnishing and installing all materials, tools, labor and all incidentals required to finish the work, complete in place and accepted by the Engineer. Additional in-line splices approved by the Engineer to facilitate the pulling of cables through long conduit runs shall not be paid separately, but shall be considered incidental to the cost of the cable.

T.04.05.3 Semi-Permanent 3-Way Splice Kits. The accepted quantity of "Semi-Permanent 3-Way Splice Kits" will be paid for at the contract unit price per each as listed in the Proposal. The price so-stated constitutes full and complete compensation for furnishing and installing all materials, tools, labor, and all other incidentals required to finish the work, complete in place and accepted by the Engineer.

SECTION T.05

HANDHOLES AND PULL BOXES

T.05.01 DESCRIPTION. This work consists of providing Precast Type A Handholes, Precast Type H Heavy Duty Handholes, and Precast Type B Pull Boxes at the locations indicated on the Plans or as directed by the Engineer. The work also includes the provision of Type W Pull Boxes on those structures indicated on the Plans. All such work will be in full accordance with these Specifications.

T.05.02 MATERIALS.

T.05.02.1 Precast Handholes and Pull Boxes. Precast handholes and pull boxes shall conform to **Subsection M.15.03.1** of these Specifications.

T.05.02.2 Metal Pull Boxes. Pull boxes shall conform to **Subsection M.15.03.2** of these Specifications.

T.05.03 CONSTRUCTION METHODS.

T.05.03.1 Plant Requirements for Precast Units.

a. Casting. Precast concrete units shall be cast true and square in accordance with the applicable details as shown on the Plans. Dimensions of units shall be accurate within the following tolerances:

Dimension	Tolerance ±
Greater than 0" to 12"	1/4"
Greater than 12" to 24"	½"
Greater than 24" to 72"	3/4"

b. Manufacture. Precast concrete units shall be designed and manufactured in accordance with ASTM C478; "Precast Concrete Manhole Sections," with the additional stipulation that the concrete mix design shall be Class XX(AE) as set forth in **SECTION 601** of these Specifications.

c. Inspection. All precast concrete units shall be inspected both at the points of manufacture and on the project site. Any units showing defects or damage shall be removed and replaced by the Contractor at no additional cost to the State.

T.05.03.2 Setting. Except as otherwise specified, precast units shall be placed on previously prepared gravel borrow subbase to the lines and grades shown on the Plans.

The grade of the handhole frame and cover shall be even with the surrounding ground or as directed by the Engineer.

All holes for conduit and ground wire shall be drilled. No punched holes will be allowed. All holes drilled in handholes shall be grouted with a material approved by the Engineer.

T.05.03.3 Metal Pull Boxes. Pull boxes, when used in cast-in-place bridge parapets or barrier, shall conform to the details indicated on the Plans and shall be adequately anchored in place to prevent displacement during concrete pouring operations.

T.05.03.4 Excavation. Excavation for precast handholes and pull boxes shall be completed as nearly as practicable to the dimensions shown on the Plans.

T.05.04 METHOD OF MEASUREMENT. "Precast Type A Handholes," "Precast Type H Heavy Duty Handholes," "Precast Type B Pull Boxes," and "Type W Pull Boxes" will be measured by the number of units, of each type, actually installed in accordance with the Plans and/or as directed by the Engineer.

T.05.05 BASIS OF PAYMENT. The accepted quantities of "Precast Type A Handholes," "Precast Type H Heavy duty Handholes," "Precast Type B Pull Boxes," and "Type W Pull Boxes" will be paid for at their respective contract unit prices per each such type as listed in the Proposal. The prices so-stated constitute full and complete compensation for all materials, labor, tools, and equipment including concrete, ground wire, grounding clamps and support grips, ground rods, gravel, cast iron frame and cover, excavation and backfill and for all incidentals required to finish the work, complete in place and accepted by the Engineer.

Payment for "Trench Excavation - Rock" will be made under the applicable provisions of **SECTION 205; TRENCH EXCAVATION**, of these Specifications.

SECTION T.06

CONDUIT

T.06.01 DESCRIPTION. This work consists of furnishing and installing rigid steel conduit and PVC plastic conduit, of the size specified, including the necessary fittings, at the locations indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

T.06.02 MATERIALS. Conduit and fittings shall conform to **Subsection M.15.04** of these Specifications.

T.06.03 CONSTRUCTION METHODS. All work shall be performed strictly in accordance with the requirements of the National Electric Code.

T.06.03.1 Rigid Steel Conduit. Conduit shall be placed as shown on the Plans or as directed by the Engineer. Bends which are not smooth or which show any evidence of flattening or destruction of the protective coating will not be accepted. All joints requiring rethreading shall be made with a zinc-based, cold galvanized, spray-applied compound as approved by the Engineer, applied to the male threads. Oils shall be removed from the threads prior to applying the galvanizing compound. All threaded couplings shall be tightened until the ends of the conduit are brought together to form a good electrical connection.

A No. 10 AWG galvanized steel pull wire shall be installed in all conduits which do not carry conductors under the contract. Such pull wire shall be for subsequent use to facilitate pulling of cables. Cost of this pull wire shall be considered incidental in the price of the conduit involved.

Conduit bends and elbows made in the field shall have a radius of not less than six times the inside diameter of the conduit, and all such bends shall be made without crimping, heating, denting or otherwise damaging the conduit.

a. Underground. All conduit shall be provided with grounding (watermain) clamps. Ends that have bonding clamps shall be filled with sealing compound to prevent the entrance of moisture, except at handholes. All ground lugs shall be copper, bronze or brass. Underground conduit shall refer to all conduit placed underground in non-paved areas or in paved areas where the pavement will be replaced as part of the project under other contract items. Underground conduit shall be placed at a minimum depth of 24 inches under vehicular travel areas and 18 inches under non-vehicular travel areas.

If the condition of the bottom of the trench is in any way unsatisfactory as determined by the Engineer, the Engineer may require the Contractor to excavate additional material and replace it with clean gravel to provide a firm bearing for the conduit. The backfill shall be compacted in layers not more than 6 inches in depth.

After the trench is backfilled, the Contractor shall, in the presence of the Engineer, test the installation by pushing or pulling a mandrel, not less than 1/4-inch less than the inside diameter

of the conduit, through the entire length of the conduit. Any debris, including stones and dirt, shall be removed. All damaged conduit shall be removed and replaced at the Contractor's expense.

b. Conduit Under Existing Pavement. Conduit under existing pavement shall refer to all conduit placed under existing paved areas where removal of the pavement is required only for the placement of conduit and the pavement is to be restored as part of this item. Conduit under existing pavement shall be placed in accordance with all applicable requirements of **Para. a** of this Subsection. The use of an automatic trenching machine is preferred. The excavation shall be patched in accordance with the Plans regardless of the method of excavation. When conduit is placed in existing paved sidewalks, the sidewalk shall be replaced in accordance with **Subsection T.01.03.11** of these Specifications.

c. Overhead. All conduit above grade shall be securely attached using clamps and/or hangers at intervals not exceeding 5 feet or as directed. All clamps and hangers shall be galvanized. A weatherhead shall be installed on all risers.

d. Conduit in Structure. Conduit to be embedded in concrete structures shall be rigidly supported in the concrete form by methods and materials which will not cause injury to the zinc coating of the conduit.

Rigid steel conduit installations on bridges and other structures shall be provided with expansion fittings at all structure expansion joints. The expansion joint fittings shall be installed as shown on the Plans and meet the requirements of **Subsection M.15.04.3** of these Specifications.

T.06.03.2 PVC Plastic Conduit. PVC plastic conduit shall be installed as shown on the Plans and in conformity with the requirements previously specified except those referring specifically to rigid steel conduit.

T.06.04 METHOD OF MEASUREMENT. "Rigid Steel Conduit" and "PVC Plastic Conduit" will be measured by the number of linear feet actually installed of the type or types indicated on the Plans and/or as directed by the Engineer, with no deduction for fittings and couplings.

T.06.05 BASIS OF PAYMENT.

T.06.05.1 Conduit Underground. The accepted quantities of "Rigid Steel Conduit -Underground" and "PVC Plastic Conduit - Underground" will be paid for at their respective contract unit prices per linear foot for the type or types as listed in the Proposal. The prices so-stated constitute full and complete compensation for all materials, equipment, tools, and labor including all fittings, couplings and restoration of existing ground surfaces, excavation and backfill, saw cutting pavements, temporary patch, testing, and all other incidentals necessary to satisfactorily finish the work, complete in place and accepted by the Engineer.

T.06.05.2 Conduit Under Existing Pavement. The accepted quantities of "Rigid Steel Conduit - Under Existing Pavement" and "PVC Plastic Conduit - Under Existing Pavement" will be paid for at their respective contract unit prices per linear foot for the type or types as listed in the Proposal. The prices so-stated constitute full and complete compensation for furnishing all materials,

equipment, tools, and labor including fittings, couplings, saw cutting, excavation and backfill, restoration of existing pavements and sidewalks, testing, and all other incidentals required to finish the work, complete in place and accepted by the Engineer.

T.06.05.3 Conduit Overhead. The accepted quantities of "Rigid Steel Conduit - Overhead" and "PVC Plastic Conduit - Overhead" will be paid for at their respective contract unit prices per linear foot for the type or types as listed in the Proposal. The prices so-stated constitute full and complete compensation for furnishing all materials, equipment, tools, and labor including fittings, couplings, clamps and hangers, and weatherhead, and all other incidentals required to finish the work, complete in place and accepted by the Engineer.

T.06.05.4 Rigid Steel Conduit in Structure. The accepted quantities of "Rigid Steel Conduit in Structure" will be paid for at their respective contract unit prices per linear foot for the various types as listed in the Proposal. The prices so-stated constitute full and complete compensation for furnishing all materials, equipment, tools, and labor including fittings, couplings, and expansion fittings, and all other incidentals necessary to satisfactorily finish the work, complete in place and accepted by the Engineer.

SECTION T.07

LUMINAIRES

T.07.01 DESCRIPTION. This work consists of furnishing and installing 250 or 400- watt high pressure sodium luminaires on appropriate lighting standards, and understructure luminaires, along with their supports and protective screens, at the locations indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

T.07.02 MATERIALS. Luminaires, understructure luminaires and photo-electric controls shall conform to **Subsection M.15.05**, of these Specifications.

T.07.03 CONSTRUCTION METHODS.

T.07.03.1 High Pressure Sodium Luminaires. The 250 or 400-watt high pressure sodium luminaires shall be installed as shown on the Plans or directed by the Engineer. Luminaires shall be securely attached to ends of arms and shall be accurately plumbed, with luminaire reflector properly and accurately placed.

T.07.03.2 Understructure Luminaire with Protective Screen. Angle iron shall be drilled to accept wire mesh. Wire mesh ends shall be crimped at every end into holes in the angle iron. The protective screen shall be of the size indicated on the Plans and shall be secured to the bridge structure with galvanized "C" clamps located in each corner. The furnishing and installing of supports for the understructure luminaires shall include the first 4 feet of 2-inch conduit installed from the luminaire. The high pressure understructure luminaire shall be furnished and installed as indicated on the Plans and/or as directed by the Engineer.

T.07.04 METHOD OF MEASUREMENT.

T.07.04.1 High Pressure Sodium Luminaires. "250 or 400-Watt High Pressure Sodium Luminaires" will be measured by the number of units actually installed in accordance with the Plans and/or as directed by the Engineer.

T.07.04.2 Understructure Luminaire with Protective Screen. "Understructure Luminaire with Protective Screen" will be measured by the number of units actually installed in accordance with the Plans and/or as directed by the Engineer.

T.07.05 BASIS OF PAYMENT.

T.07.05.1 High Pressure Sodium Luminaires. The accepted quantities of "250 or 400-Watt High Pressure Sodium Luminaires" will be paid for at the contract unit price per each as listed in the Proposal. The price so-stated constitutes full and complete compensation for all materials, equipment, tools, and labor including ballast, lamp and photo-electric control, and all other incidentals required to finish the work, complete in place and accepted by the Engineer.

T.07.05.2 Understructure Luminaire with Protective Screen. The accepted quantities of "Understructure Luminaires with Protective Screens" will be paid for at the contract unit price per each as listed in the Proposal. The price so-stated constitutes full and complete compensation for all materials, including angle, mesh, and clamps for the protective screen, luminaire support, luminaire, ballast, photo-electric cell, lamp, and conduit, and all labor, tools, equipment, and all incidentals required to finish the work, complete in place and accepted by the Engineer.

SECTION T.08

ALUMINUM LIGHTING STANDARDS AND FOUNDATIONS

T.08.01 DESCRIPTION. This work consists of furnishing and installing aluminum lighting standards, foundations, anchor bolts, and breakaway support couplings of the sizes and at the locations indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

T.08.02 MATERIALS.

T.08.02.1 Light Standards. Light Standards shall conform to **Subsection M.15.06.1** of these Specifications.

T.08.02.2 Light Standard Foundations. Light standard foundations shall conform to **Subsection M.15.06.2** of these Specifications.

T.08.03 CONSTRUCTION METHODS.

T.08.03.1 Light Standards. Lighting standards shall be securely bolted to foundations in a vertical position employing approved shims if necessary.

Arms shall be securely attached to poles in such a manner as to develop the full design strength of the arm and shall be aligned perpendicular to centerline of roadway.

The use of breakaway support couplings shall be limited to pole heights that provide luminaire mounting heights of 50 feet or less and a total pole, arm and luminaire weight of 600 pounds or less.

T.08.03.2 Light Standard Foundations.

a. Cast-in-Place Concrete Units. Excavation shall be completed as nearly as practicable to the dimensions shown for the concrete foundation. All loose material shall be removed before the forms are installed. All conduits, ground rods, reinforcing steel and anchor bolts shall be installed rigidly in place before the concrete is placed. Anchor bolts shall be spaced by means of a template furnished by the pole manufacturer. Anchor bolts and conduit extending above the top of the base shall be wrapped with oiled burlap for protection until the post is mounted on the base. The concrete shall be placed in accordance with **SECTION 808; CAST-IN-PLACE STRUCTURE CONCRETE MASONRY** of these Specifications.

Grounding shall be accomplished through the ground rod in the associated handhole with a bare copper ground wire. If there is no associated handhole, and when called for in the Plans, a ground rod shall be installed in the light standard foundation. The ground rod shall extend 3 inches above the top of the base and shall be equipped with a copper clamp to secure the ground wire.

After the concrete foundation has been poured, finished level and cured, forms shall be removed. The area around the concrete base shall be backfilled and compacted in 6-inch uniform layers. Available stones in the area shall be used to chink the backfill to insure the concrete foundation remains in a stable vertical position.

The Contractor shall protect the foundation and anchor bolts until the system is fully accepted by the State. Foundations or anchor bolts damaged, prior to final acceptance, shall be replaced at no additional cost to the State.

After backfilling, all pavement or surface treatment which has been disturbed by the construction operation shall be replaced with similar material in a manner satisfactory to the Engineer at no additional cost to the State.

The site shall be neatly trimmed and left in a satisfactory condition. All excess materials shall be removed and disposed of by the Contractor in accordance with the applicable requirements of **SECTION 202; EXCAVATION AND EMBANKMENT** of these Specifications.

b. Precast Units. Precast foundation units shall be manufactured in accordance with the applicable provisions of **SECTION 601** and **SECTION 809; PORTLAND CEMENT CONCRETE** and **PRECAST/PRESTRESSED STRUCTURE CONCRETE MASONRY**, respectively, of these Specifications.

1. Reinforcement. All reinforcing bars shall have a minimum cover of 3 inches.

2. Dowels. Dowels shall be accurately set and maintained at right angles to the plane of the top of the unit.

3. Casting. Precast concrete foundation units shall be cast true and square in accordance with the applicable details indicated on the Plans. Dimension of units shall be accurate within the following tolerances.

Dimension	Tolerance ±
Greater than 0" to 12"	1/4"
Greater than 12" to 24"	½"
Greater than 24" to 72"	3/4"

4. Inspection. All precast concrete foundation units shall be inspected both at the points of manufacture and on the project site. Any units showing defects or damage shall be removed and replaced by the Contractor at no additional cost to the State.

c. Preparation of Subbase. The subbase shall be furnished and placed in accordance with **Subsections 302.03.1** and **302.03.2; Placing and Shaping and Compaction**, respectively, of these Specifications.

d. Setting. Units shall be placed on previously prepared gravel borrow subbase to the lines and grades shown on the Plans.

Care shall be exercised during hauling, storage, hoisting and handling of the units to prevent cracking or damage. No damaged units shall be installed. Units showing defects or damage shall be removed and replaced or repaired by the Contractor at no additional cost to the State.

T.08.03.3 Breakaway Support Couplings. The installation instructions shall be in strict conformance with the manufacturer's recommendations, using torque control nuts or galvanized steel hex nuts which yield at the load specified by the manufacturer.

T.08.04 METHOD OF MEASUREMENT.

T.08.04.1 Light Standards. "Light Standards" will be measured by the number of units actually furnished and installed in accordance with the Plans and/or as directed by the Engineer.

T.08.04.2 Light Standard Foundation with Anchor Bolts. "Light Standard Foundations with Anchor Bolts" will be measured by the number of units actually furnished and installed in accordance with the Plans and/or as directed by the Engineer.

The 2-inch rigid steel conduit contained within the concrete base and the first 4 inches outside thereof will be considered as part of the foundation unit and will not be paid for separately.

T.08.04.3 Breakaway Support Couplings.

a. New Foundations. "Breakaway Support Couplings for Light Standards" will not be measured separately for payment but will be included in the payment for "Light Standard Foundation with Anchor Bolts."

b. Existing Foundations. Breakaway couplings to be installed on existing foundations will be measured by the number of existing foundations on which a set of four such couplings are to be installed, all in accordance with the Plans and/or as directed by the Engineer.

T.08.05 BASIS OF PAYMENT.

T.08.05.1 Light Standards. The accepted quantities of "Light Standards" will be paid for at the contract unit price per each as listed in the Proposal. The price so-stated constitutes full and complete compensation for all materials including poles, cast aluminum bases, ground wire, ground lugs, grounding bushings, No. 10 AWG cable and in-line fuses and for all labor, tools, equipment and incidentals required to finish the work, complete in place and accepted by the Engineer.

T.08.05.2 Light Standard Foundations with Anchor Bolts. "Light Standard Foundations with Anchor Bolts" will be paid for at the contract unit price per each as listed in the Proposal. The price so-stated constitutes full and complete compensation for all materials, including anchor bolts, breakaway support couplings, ground rods, reinforcing steel, conduit, conduit couplings, washers and nuts, excavation, backfilling and compaction, replacing flexible pavement, concrete, or other surface treatment, and for all labor, tools, equipment and incidentals required to finish the work, complete in place and accepted by the Engineer.

Allowance for rock excavation shall be made for a distance of one foot outside the foundation and 6 inches below the bottom of the foundation, as constructed, and will be paid for as "Trench Excavation - Rock" under the applicable provisions of **SECTION 205; TRENCH EXCAVATION**, of these Specifications.

T.08.05.3 Furnish and Install Breakaway Support Couplings on Existing Light Standard Foundations. "Furnish and Install Breakaway Support Couplings on Existing Light Standard Foundations" will be paid for at the contract unit price per each existing foundation as listed in the Proposal. The price so-stated constitutes full and complete compensation for all materials, labor, tools and equipment, including furnishing and installing breakaway support couplings on each existing light standard foundation anchor bolt, removing and resetting existing light standards on the existing foundations, extending existing conduit stubs, and all other incidentals required to finish the work, complete in place and accepted by the Engineer.

SECTION T.09

SERVICE PEDESTAL

T.09.01 DESCRIPTION. This work consists of furnishing and placing the service pedestal, the service riser, concrete mat, and anchor bolts at the locations indicated on the Plans or as directed

by the Engineer, complete in every respect, fully wired, thoroughly tested and ready for use, all in accordance with these Specifications.

Electric service shall be as specified on the Plans, and available at the indicated transformer. The Contractor shall provide the conductors of the size indicated.

T.09.02 MATERIALS. All materials for this item of work shall conform to **Subsection M.15.07; Service Pedestal**, of these Specifications.

T.09.03 CONSTRUCTION METHODS. All work shall be performed in accordance with the National Electric Code, and the National Electric Safety Code. The service pedestal shall be installed as shown on the Plans or as directed by the Engineer. The work under this item shall include all conduit contained within the concrete base. The pedestal shall be installed on the concrete mat as indicated on the Plans with the power distribution panel mounted inside. The concrete pad shall be placed on 12 inches of gravel subbase. The enclosure shall be made watertight. A bead of silicon sealer shall be applied to the base of the cabinet, inside and out. All electrical conductors within the cabinet shall be enclosed in PVC conduit. The electrical components shall be mounted with machine screws and wired as shown on the Plans or as directed. All rigid steel conduits in the service cabinet shall be bonded together and grounded to the cabinet with No. 6 AWG bare copper conductors. A ground rod shall be driven into the ground and stubbed up 6 inches above the mat. A No. 6 AWG bare copper grounding conductor from the neutral bus shall run continuous to the ground rod.

T.09.04 METHOD OF MEASUREMENT. "Service Pedestal" will be measured by the number of units actually furnished and installed in accordance with the Plans and/or as directed by the Engineer.

T.09.05 BASIS OF PAYMENT. The accepted quantities of "Service Pedestal" will be paid for at the contract unit price per each as listed in the Proposal. The price so-stated constitutes full and complete compensation for all material, labor and equipment, including furnishing and installing the service pedestal, anchor bolts, concrete foundation, crushed stone, excavation and backfill, meter socket, contactor, panelboard, photo control, relays, neoprene gasket, grounding bushings, ground rod, and ground wire and for all incidentals required to finish the work, complete in place and accepted by the Engineer.

SECTION T.10

TRAFFIC SIGNAL SYSTEMS

T.10.01 DESCRIPTION. This work consists of furnishing and installing all necessary materials and equipment in order to complete the new traffic signal systems, at the locations designated on the Plans and/or as directed by the Engineer, all in accordance with these Specifications.

Reference is made to the following Sections which are relevant to traffic signal systems.

T.10.02 MATERIALS. Signal heads, controllers, standards and posts, electrical conduits and fittings, wire and cable, detectors and relays, handholes, and pull boxes shall conform to the applicable requirements of **SECTION M.15; TRAFFIC CONTROL SYSTEMS**, of these Specifications, and the National Electric Code. Concrete for foundations shall be as specified in **SECTION 601; PORTLAND CEMENT CONCRETE**, of these Specifications.

Unless otherwise indicated on the Plans or specified, all materials shall be new.

T.10.02.1 Warranties for Traffic Signal Systems.

a. Manufacturer's Warranties. Copies of any warranties that the Contractor receives from each manufacturer on all electrical or mechanical equipment pertinent to the complete and satisfactory operation of traffic signal installations shall be turned over to the Department at the time of acceptance at no cost to the Department. Each warranty so furnished shall indicate its expiration date, and be in effect for a period equal to the customary trade practice.

b. Contractor's Warranties. The Contractor will warranty the satisfactory in service operation of the mechanical and electrical equipment and related components for six months following the acceptance of the contract by the State. During this period it will be the Contractor's responsibility, when notified by the Engineer, to repair or replace equipment or materials necessary to insure satisfactory operation of the system, and to correct malfunctions attributable to installation deficiencies.

The Contractor, at his own expense, must install a temporary traffic controller and replace any auxiliary equipment in the control cabinet, as approved by the Engineer, when the approved traffic controller or auxiliary equipment must be removed from the job site for repairs in order that the traffic signal system is operating immediately after the Contractor has been notified of any breakdown or malfunction of any unit.

The Contractor, at his own expense, must install a new controller that meets the Plans and Specifications of the contract and the approval of the Engineer when the approved traffic controller cannot be repaired within 30 days after any breakdown or malfunction of any controller part. The new controller must conform to the Plans and these Specifications.

The Contractor will be back-charged by the Maintenance Division of the Rhode Island Department of Transportation for all tools, workmanship, parts, equipment and all appurtenances necessary to repair or replace any controller part or auxiliary equipment in the control cabinet that malfunctions within the above guarantee period in order to maintain the traffic signal system in proper operating condition at all times as approved by the Engineer.

All workmanship, parts, tools, equipment and all appurtenances necessary to correct malfunctions attributable to installation deficiencies are to be supplied by the Contractor at his own expense. Any labor necessary to comply with the requirements of the manufacturer's and Contractor's warranties will be compensated by force account.

T.10.03 CONSTRUCTION METHODS. The applicable requirements of **Subsections T.01.03, T.03.03, T.04.03, T.05.03, T.06.03, T.11.03, T.12.03, T.13.03**, and **T.14.03** shall apply.

Poles, pedestals and controller cabinets shall be securely bolted to foundations in a vertical position, employing approved shims if required. Push button assemblies shall be accurately positioned and securely fastened in place. Push button assemblies shall be installed on poles, pedestals, wrought iron pipe standards or on controller cabinets as shown on the Plans, to form the push button stations. Mast arm poles, span poles, controller cabinets, and signal heads shall be positioned as shown on the Plans or as directed by the Engineer. The final location shall be approved by the Engineer in the field prior to installation.

All wiring shall be installed, and the bonding and grounding shall be performed in conformance with the Plans, the requirements of the National Electric Code, and requirements of **Subsection T.01.03.2.**

In addition, all splices made in wiring signals shall be made inside the signal heads at the provided terminal strips.

Rigid steel conduits, poles, pedestals, detectors, controller cabinets, and pedestrian push button stations shall be effectively bonded and grounded.

All improvements and equipment disturbed, damaged, or removed during foundation construction shall be removed and replaced or repaired to the satisfaction of the Engineer at no additional cost to the State.

Incidental parts not shown on the Plans or specified, which are required to complete the traffic signal or other electrical systems, shall be furnished and installed as though such parts were shown on the Plans or specified, at no additional cost to the State. All systems shall be complete and in operation to the satisfaction of the Engineer at the time of completion of the work. All such incidental parts shall be approved by the Engineer prior to installation.

T.10.04 METHOD OF MEASUREMENT. "Traffic Signal Systems" will not be measured separately but will be included in the measurements of specific items such as conduit, cable, controllers, signal heads, etc. Refer to **SECTIONS T.04 through T.06** and **T.11 through T.14** for specific methods of measurement.

T.10.05 BASIS OF PAYMENT. "Traffic Signal Systems" will not be paid for separately but will be included in the price of specific items as outlined in **Subsection T.10.04.**

Full compensation for all additional materials and labor, not shown on the Plans or specified, which are necessary to complete the installation of the traffic signal systems, shall be considered as included in the prices bid for the individual items, and no additional allowance will be made therefor.

SECTION T.11

TRAFFIC SIGNAL STANDARDS AND POSTS

T.11.01 DESCRIPTION. This work consists of furnishing and installing Galvanized Steel Mast Arms and Poles with Foundations, Galvanized Steel Span Poles with Foundations, and Wood Span Poles at the locations indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

T.11.02 MATERIALS.

T.11.02.1 Design. Traffic signal poles, mast arms, span poles, connections, clamps, anchor bolts, shoe bases and all other members shall be designed and fabricated in accordance with the requirements of the latest edition (and interim specifications) of the AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals," and shall be designed to withstand the specified forces including those produced by a basic wind speed of 130 miles per hour.

The span poles shall be designed to withstand a dead load cable sag of 5 percent of the span length and for a maximum allowable dead load pole deflection as specified in **Subsection T.11.03.2**. The Engineer reserves the right to reject a pole design if the calculated deflection exceeds that specified therein.

Vibration mitigation devices will not be allowed.

All traffic signal structures must comply with fatigue Category II requirements, including galloping, vortex shedding (if applicable), natural wind gusts, and truck induced gusts. The truck induced loading is based on 30 mph velocity.

Cantilever traffic signal structures that have tapers of 0.14 inches per foot or greater are not susceptible to vortex shedding.

Structure 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.

When the clearance between the bottom of the leveling nuts and the top of the concrete is equal to or greater than one bolt diameter, bending stresses in the anchor bolts shall be considered in the design.

The following notes shall be included on all plans and/or shop drawings in reference to anchor bolts:

> Pretensioning of all anchor nuts is required, and shall be accomplished by tightening to 1/6th turn beyond the snug-tight position.

The maximum clearance between the bottom of the leveling nuts and the top of the concrete is critical and shall not exceed the amount specified on the drawing.

T.11.02.2 Manufacture. Traffic signal mast arms and poles and span poles shall be manufactured with high strength, galvanized steel. If the pole or mast arm is manufactured in two pieces, the sections shall be joined by an approved method. All materials for the structure, including anchor bolts, bolt covers, and hardware must meet the approval of the Engineer. The threaded ends of the anchor bolts and the nuts and lock washers shall be hot-dipped galvanized in accordance with ASTM A153 or A123.

T.11.03 CONSTRUCTION METHODS. Standards and posts for traffic signals shall be installed as indicated on the Plans and shall conform to the following requirements:

T11.03.1 Steel Poles.

a. Workmanship and finish shall be equal to the best general practice of modern metal fabrication shops.

b. Traffic Signal Poles may be tubular, hexagonal, octagonal, or elliptical, of constant section or tapered, and shall be capable of withstanding the applied load shown on the Plans with the maximum deflection as indicated above without the necessity of a back guy. Traffic signal poles shall be installed in accordance with the National Electric Safety Code.

A maximum static deflection of 4 inches, without wind load, will be permitted for span poles not over 35 feet in height, and 4½-inches for span poles greater than 35 feet in height. Static deflection shall be measured by the Engineer with the span wires and signal heads in place.

The span poles shall be raked back to allow for the anticipated dead load pole deflection as indicated in the Shop Drawings such that the final position of the poles under dead load is essentially vertical. The shop drawings shall indicate the theoretical dead load deflection.

c. Foundations. The foundations shall be constructed in accordance with **Subsection T.01.03.1.** The dimensions and reinforcing steel shall be in accordance with the requirements of the Plans. In the event that the design loads produce a base moment in excess of those indicated on the Plans, the Contractor will be required to provide at its own expense, a foundation design by a Rhode Island Registered Professional Engineer in accordance with the AASHTO Standard Specifications and detailed similarly to the Plans.

The use of grout under base plates is generally not be permitted. If specific conditions warrant its use, the grout shall not be considered load carrying. Loads shall be directly supported by the anchor bolts. Adequate drainage shall be provided.

Headed cast-in-place anchor bolts shall be used in lieu of hooked anchor bolts.

The top 12 inches of the foundation shall be formed, and the remainder shall be cast against undisturbed earth. If adjacent earth is disturbed or removed beyond the neat lines of the foundation, it shall be replaced with concrete fill. This excavation shall be no larger than 1 foot greater than the dimension of the foundation, unless authorized by the Engineer. The top of

foundation shall be set to finished grade and finished level. After curing, the forms shall be removed and backfilled with suitable material and compacted in 12-inch layers.

T.11.03.2 Wood Poles. Wood poles used for span wire suspensions shall conform with the applicable requirements of **Subsection M.15.07.6**, of these Specifications. The hole to receive the pole shall be 6 feet in depth and 28 inches to 32 inches in diameter. The pole, after being placed into position, shall be backfilled with a one-foot layer of crushed rock or coarse gravel and the remaining space shall be backfilled with earth, tamped down in 12-inch intervals until the hole is filled.

Guy anchors required for wood poles shall be installed in accordance with the following:

Contact Area of Anchor:	
Normal soil conditions:	192 sq. in. minimum
Sandy or marshy conditions:	300 sq. in. minimum
Minimum depth of anchor hole:	5.5 feet.
Anchor rod:	5/8" x 7', double eye.

Eye shall project above grade 4" to 6."
Dig channel for rod to line up guy.
Fit anchor in hole with anchor rod laying in channel.
Tamp crushed stone or coarse gravel between anchor face and undisturbed earth.
Backfill all removed earth, compacted in 1-foot layers.

T.11.04 METHOD OF MEASUREMENT. "Galvanized Steel Mast Arms and Poles and Foundations," "Traffic Signal Standards - Galvanized Steel and Foundations," and "Traffic Signal Standards - Wood" will be measured by the number of units of each such type actually installed in accordance with the Plans or as directed by the Engineer.

T.11.05 BASIS OF PAYMENT. The accepted quantity of "Galvanized Steel Mast Arms and Poles and Foundations," "Traffic Signal Standards - Galvanized Steel and Foundations," and "Traffic Signal Standards - Wood" will be paid for at their respective contract unit prices per each such type as listed in the Proposal. The prices so-stated constitute full and complete compensation for all design, materials, labor, tools, equipment and all incidentals required to finish the work, complete in place and accepted by the Engineer.

SECTION T.12

TRAFFIC SIGNAL CONTROLLERS AND CABINETS

T.12.01 DESCRIPTION. This work consists of supplying and installing a NEMA TS-2 Type 1 actuated traffic signal controller with internal time-base coordination and internal pre-emption capabilities at the locations indicated on the Plans or as directed by the Engineer, along with any necessary appurtenances, all in accordance with these Specifications. All controllers supplied for this project shall be identical models of current production and recent manufacture. Untried or prototype units shall not be acceptable. All software supplied shall be of the most recent revision.

T.12.02 MATERIALS. Traffic Signal Controllers and Cabinets shall conform to the applicable requirements of **Subsection M.15.13; Traffic Signal Controllers and Controller Cabinets** of these Specifications.

T.12.03 CONSTRUCTION METHODS.

T.12.03.1 The New Installation. Controllers and cabinets shall be installed in strict accordance with the manufacturer's recommendations and the latest edition of the NEMA Standards.

T.12.03.2 Temporary Controllers. When traffic signal poles, signal heads, conduit conductor cable, detectors and other traffic signal appurtenances are installed, and if the specified controller is not available, the Contractor shall immediately provide, at his own expense, a temporary controller capable of operating the installation as specified on the Plans.

T.12.04 METHOD OF MEASUREMENT. "16-Phase Actuated Controllers, Cabinets and Foundations" will be measured by the number of units of the type or types actually installed in accordance with the Plans and/or as directed by the Engineer.

T.12.05 BASIS OF PAYMENT. The accepted quantities of "16-Phase Actuated Controllers, Cabinets and Foundations" will be paid for at the contract unit price per each type or types as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, materials, tools, and equipment, including mounting hardware, foundations, concrete work pad, ground wire, ground rod, malfunction management unit (MMU), bus interface unit (BIU), detector racks, programming and all required tests, and appurtenances, and other incidentals required to finish the work, complete and accepted by the Engineer.

SECTION T.13

DETECTORS AND RELAYS

T.13.01 DESCRIPTION. This work consists of furnishing and installing inductance loop vehicle detectors, loop detector relays, pedestrian detectors, and necessary wiring and appurtenances at the locations indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

T.13.02 MATERIALS. Loop detector wire, loop detector lead-in cable, loop detector relays, and pedestrian detectors shall conform to **Subsections M.15.02.5, M.15.02.6, M.15.14 and M.15.17,** respectively, of these Specifications.

T.13.03 CONSTRUCTION METHODS.

T.13.03.1 Scheduling Loop Detector Installations. The Contractor must schedule loop detector installations such that no roadway approach is without detection for more than 30 calendar days. Once a loop detector has been disconnected due to pavement removal, trench

excavation for drainage or utility work, conduit installation, or any other construction activity, the Contractor must restore loop detection within 30 calendar days, unless otherwise authorized in writing by the Engineer.

T.13.03.2 Inductance Loop Detector Installation. Inductance loops shall be installed in accordance with the details specified on the Plans, or as directed by the Engineer. Loop dimensions shall be as specified on the Plans. Handholes, conduits and curb cuts shall be completed before beginning the loop installation. The loop shall be outlined on the pavement to conform to the specified configuration.

A power saw shall be used to cut a slot in the pavement. The cut shall be of sufficient width (min. 3/8") to allow easy placement of loop wire (single or twisted pair) into the saw cut and have a depth which will place the last loop turn from 1½-inches to 2½-inches below the final surface unless specified otherwise on the Plans. The corners shall be saw cut, cored, drilled or chipped out as indicated on the Plans. Sharp edges in the corners shall be smoothed. The intersection of saw cuts shall overlap so that the slots have full depth and a smooth bottom.

Immediately after sawing, the slot and pavement shall be flushed with high pressure clean water to remove the saw slurry. Filtered compressed air shall be used to remove all dust and moisture from the slot. The installation shall not proceed until the slot is dry. Hot air may be used to dry the saw slot.

To protect the loop wire at the edge of the pavement or curb, 1-inch minimum diameter flexible PVC or vinyl conduit(s) shall be installed between the pavement and handhole, in accordance with the details indicated on the Plans.

The loop wire shall be installed starting at the roadside handhole, around the loop for the specified number of turns, and back to the handhole. Splices shall not be permitted outside the handhole. The wire shall be depressed in the slot without the use of sharp objects which might damage the wire insulation. The loop shall be held in place every 2 feet with 2-inch (approximate) strips of open-celled polyurethane backer rod as approved by the Engineer. These hold down strips shall be left in place when the slot is filled with roadway loop embedding sealer. Where the loop wire crosses pavement joints and cracks, the loop wires shall be further protected using the method specified on the Plans.

The ends of the vinyl or PVC tubing encasing the wire shall be given a waterproof seal immediately after placing the wire to prevent moisture from entering the tube. The tubing shall be of a continuous length from the curb to the handhole.

The pair of loop wires between the edge of the loop and the splice to the shielded lead-in cable in the handhole shall be twisted together 3 to 5 turns per foot.

The splice between the loop wires (twisted pair) and the shielded lead-in cable shall be moisture proof and shall have a dielectric strength at least equal to that of the original insulation.

Moisture shall be excluded from the splice during the operation and the work shall be done in dry weather or under shelter. All parts of the splice and tools involved shall be clean and dry. Individual splices in each wire shall be staggered in a manner so as to minimize the outside diameter of the finished splice. The bared conductor ends shall be twisted and soldered and reinsulated using an electrical grade fast drying sealant and plastic polyvinyl chloride tape. The

reinsulation shall extend approximately one inch onto the adjacent insulation at each end. Sufficient layers of tape shall be applied such that the thickness is one and one half times that of the original insulation.

Reinsulation of the outer jacket shall be accomplished in a similar manner except that the reinsulation shall extend approximately 4 inches onto the adjacent jacket at each end.

The shielded lead-in cable shall be continued (no splices) from the splices to the loop wires, to the controller cabinet terminals only.

The completed loop installation, including the shielded lead-in to the controller cabinet, shall have a minimum of 50 megohms leakage resistance to ground. This resistance shall be tested after the splice is made between the loop wires (twisted pair) and shielded lead-in.

The Contractor, in addition to measuring the leakage to ground, shall, by test instruments capable of measuring electrical values of the installed loop wires and lead-ins, measure induced AC voltage, inductance in microhenries, high "Q" indication, and the resistance of the conductors in ohms. Upon measuring the loops, the Contractor shall report to the Engineer any unusual readings, or readings not in agreement with the calculated values. Testing of the loop may take place during or after the installation of the loop. When a loop is found to be not in accordance with calculated values, a new loop will be installed in its place at the Contractor's expense.

The pavement temperatures shall be 40°F and rising before the sealer is placed. All work involving the sealer shall be done in compliance with the manufacturer's specifications. When the loop embedding sealer has set sufficiently to open the loop to traffic, but the surface remains tacky, the loop may be dusted with cement to facilitate opening the loop to traffic.

T.13.03.3 Pedestrian Detector Installation. Pedestrian pushbuttons shall be installed in accordance with **Subsection T.10.03** of these Specifications. All pushbuttons, regardless of mounting type, shall be mounted at a height of 3 feet 6 inches. The measurement shall be made from the center of the pushbuttons to the finished sidewalk elevation.

All pushbutton housings shall be painted “Federal Yellow” unless other signal equipment within the same intersection is being painted a different color. In such case, the color of the pushbutton housing shall match that of the other equipment.

T.13.04 METHOD OF MEASUREMENT.

T.13.04.1 Traffic Detector Loop. "Traffic Detector Loops" will be measured by the number of linear feet of saw cut actually made in accordance with the Plans and/or as directed by the Engineer.

T.13.04.2 Traffic Detector Relays - Loop, 2 and 4 Channel. "Traffic Detector Relays - Loop, 2 and 4 Channel" will be measured by the number of units actually furnished and installed in accordance with the Plans and/or as directed by the Engineer.

T.13.04.3 Pedestrian Detectors. “Pedestrian Detector-Pushbutton with Sign” will be measured by the number of units actually furnished and installed in accordance with the Plans and/or as directed by the Engineer.

T.13.05 BASIS OF PAYMENT.

T.13.05.1 Traffic Detector Loop. The accepted quantities of "Traffic Detector - Loop" will be paid for at the contract unit price per linear foot of saw cut as listed in the Proposal. The price so-stated constitutes full and complete compensation for all materials, tools, labor and equipment, including saw cut, loop cable, flexible PVC or vinyl conduit under the curb, sealing compound, splicing and connecting, testing, and all other incidentals required to finish the work, complete in place and accepted by the Engineer.

When replacing existing loops, the cost of installing flexible conduit between the handhole and the curb shall be included in the cost of the loop.

T.13.05.2 Traffic Detector Relays - Loop, 2 and 4 Channel. The accepted quantity of "Traffic Detector Relays - Loop, 2 and 4 Channel" will be paid for at their respective contract unit prices per each type or types as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, materials, tools, and equipment, and all other incidentals required to finish the work, complete in place and accepted by the Engineer.

T.13.05.3 Pedestrian Detectors. The accepted quantity of “Pedestrian Detectors - Pushbutton with Sign” will be paid for at the contract unit price per each as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, tools and equipment including ADA compliant pushbutton and housing, wiring, sign, sign hardware, and all other incidentals required to finish the work, complete in place and accepted by the Engineer.

T.13.05.4 Failure to Comply. Subsection T.13.03.1 requires that no roadway approach may be without loop detection for more than 30 calendar days. If, in the judgement of the Engineer, the Contractor has failed to comply with this requirement, liquidated damages and penalties will be assessed. For each day the Engineer determines that the Contractor has failed to comply with the provisions of this Section, the daily charge set forth in **Special Provision Code T.13.1000** will be deducted from monies then due the Contractor.

SECTION T.14

TRAFFIC SIGNAL HEADS

T.14.01 DESCRIPTION. This work consists of furnishing and installing Vehicular Signal Heads and Pedestrian Signal Heads as shown on the Plans or as directed by the Engineer, all in accordance with these Specifications.

T.14.02 MATERIALS. Materials shall conform to the applicable requirements of **SECTION M.15; TRAFFIC CONTROL SYSTEMS**, of these Specifications.

T.14.03 CONSTRUCTION METHODS. Vehicular signal heads are to be attached to mast arms and span wires with cast iron or steel signal head hanger assemblies and galvanized steel safety chains.

The bottom of the signal head housing shall be mounted such that it is not less than 16 feet 3 inches above the roadway for a 3-section head or 15 feet above the roadway for a 4-section head. In no instance shall the bottom of the housing be more than 19 feet above the roadway. When mounted over a sidewalk, the bottom of a vehicular signal head shall be 10 feet above the sidewalk. Pedestrian signal heads shall be 8 feet above the finished sidewalk. The Contractor shall include 2 feet of slack in the cable to form a drip loop adjacent to the signal head. If within the duration of the Contract or before the installation has been accepted by the State, the signal heads are determined to be less than the minimum height, they shall be adjusted to meet the required clearance at no additional cost to the State.

The signal heads shall be mounted such that the top of the assembly does not exceed the heights shown in Figure 4D-1 in the Manual of Uniform Traffic Control Devices, Millennium Edition.

All new signal heads shall be supplied with red, yellow and green L.E.D. modules. The modules shall be installed in accordance with the manufacturer's recommendations.

When vehicular or pedestrian signal heads are bracket mounted to steel or aluminum poles, they shall be mounted to the pole using stainless steel straps. When vehicular or pedestrian signal heads are mounted on wood poles, they shall be attached with bolts.

At all new locations, work to make the system fully operational will be completed before the signal heads are installed. The heads will be installed and the system immediately put into the "flash" mode.

At locations with existing signals, all new signal heads shall be covered with an opaque material upon erection, which, when in place, will assure passing motorists that the signal heads are not in operation. The covering is to remain in place until the new signal system is operational, at which time the existing signal heads shall be covered or removed.

T.14.04 METHOD OF MEASUREMENT. "Vehicular and Pedestrian Signal Heads" will be measured by the number of units of the type or types actually installed in accordance with the Plans and/or as directed by the Engineer.

T.14.05 BASIS OF PAYMENT. The accepted quantity of "Vehicular and Pedestrian Signal Heads" will be paid for at their respective contract unit prices per each type or types as listed in the Proposal. The prices so-stated constitute full and complete compensation for furnishing and installing all materials, tools, labor and equipment including mounting hardware, tethering hardware, safety chains, lamps, L.E.D. modules, and all other incidentals required to finish the work, complete in place and accepted by the Engineer.

SECTION T.15

DIRECTIONAL, REGULATORY, AND WARNING SIGNS

T.15.01 DESCRIPTION. This work consists of furnishing and installing directional, regulatory, and warning signs on wood posts, square tubular steel posts, tubular steel posts, U-channels or traffic signal supports, and reflective sheeting, all in accordance with these Specifications, at the locations indicated on the Plans and/or as directed by the Engineer. Also included is the removal and relocation of existing directional, regulatory, and warning signs.

T.15.02 MATERIALS. Aluminum sheets, sign posts, reflective sheeting, and hardware shall conform to the applicable requirements of **SECTION M.16; SIGNS AND SIGN SUPPORTS**, of these Specifications.

T.15.03 CONSTRUCTION METHODS.

T.15.03.1 Preparation of Aluminum Sheets. Prior to application of reflective sheeting, the aluminum sign sheets shall be treated in strict accordance with the following procedure:

a. The sign panel shall be degreased by total immersion in a saturated vapor of trichloroethylene. Trademark printing shall be removed with lacquer thinner or controlled alkaline cleaning system.

b. Preliminary cleaning shall be followed by a surface etch in a 6-to-8 percent phosphoric acid solution at 100°F followed by spraying with a cold water rinse and immersion for one minute in circulating hot water at not less than 180°F. The surface etch shall provide a clean, non-shine or non-glare finish suitable for the application of sheeting.

c. The sign panel shall be dried by the use of a forced hot air drier.

d. No metal shall be handled, except by device or clean canvas gloves, between all cleaning and etching operations and the application of paint or reflective sheeting. There shall be no opportunity for metal to come in contact with grease, oils or other contaminants after cleaning and etching and prior to the application of paint or reflective sheeting.

T.15.03.2 Sign Face. The design, color, type, size and dimensions of the sign faces shall conform to the Plans and to the applicable requirements of the latest edition and revisions of the "Manual on Uniform Traffic Control Devices. Alphabet designs of upper and lower case letters and spacing of letters shall conform to the Standard Alphabets for Highway Signs, published by the U.S. Department of Transportation, Federal Highway Administration.

The Engineer reserves the right to make any changes in sign texts prior to sign manufacture at no additional expense to the State. Drawings showing dimensions, sizes, shapes and spacing of letters and arrows for all directional signs shall be submitted to the Engineer within 30 days following the award of the Contract.

T.15.03.3 Application of Reflective Sheeting and Finish.

a. Method. Application of reflective sheeting shall be by the mechanical squeeze roller applicator method in accordance with the recommendations of the manufacturer.

b. Splices. At splices, pressure-sensitive, adhesive-coated sheeting shall be overlapped not less than 3/16-inch. Heat-activated, adhesive-coated sheeting may be spliced with overlap not less than 3/16-inch or butted, gap not to exceed 1/32-inch. Only butt splices shall be permitted on signs screen processed with transparent color. Sheeting applied to extruded sections shall extend over top edges and down side legs a minimum of 1/16-inch.

c. Finish. Reflective sheeting splices and sign edges shall be sealed and signs clear coated with materials supplied and in accordance with the manufacturer's instructions.

T.15.03.4 Locations. The approximate locations of the signs are shown on the Plans, but exact locations shall be determined in the field by the Engineer. Posts shall be erected plumb. Signs shall be erected to face 2 degrees away from the direction of approaching traffic so that there will be no specular glare from the reflective sheeting.

Steet signs shall be mounted horizontally on the posts in accordance with standard commercial processes as approved by the Engineer.

Side-of-road signs shall be mounted at locations indicated on the Plans. The height of the sign shall be determined in accordance with the Plans; the Manual on Uniform Traffic Control Devices; or as directed by the Engineer.

T.15.03.5 Post Holes. Post holes shall be excavated to the depth and in the position shown on the Plans, or as indicated by the Engineer. A tolerance of plus or minus 3 inches will be permitted in the depth of the holes for wood posts. The exposed portions of the posts shall be set plumb and true to line and grade, and holes shall be backfilled with sound earth and tamped in 6-inch layers in such a way as not to displace the posts.

Post holes to be excavated through an existing concrete or asphalt surface shall be backfilled with earth as prescribed above to within 4 inches of the original grade. After this is completed, 4 inches of concrete shall be placed in the hole and the surface leveled and finished with the original grade.

When sign posts, except U-channels, are to be installed within areas where new concrete or asphalt pavement is to be placed, the following method shall be used. At the post location, a square wood box will be installed. The side dimension of the box shall be 4 inches larger than the greatest dimension of the required post, but no less than 8 inches, and its depth shall be 6 inches. The box shall be firmly anchored and shall be placed such that the top of the box is at the finished grade of the pavement. The pavement shall be installed around the box. The required post hole shall then be excavated within the area of the box, and the post will be installed, with the proper backfilling, as described above.

T.15.03.6 Remove and Relocate Signs. The sign panels and posts shall be relocated as a complete unit. If any hardware or posts are damaged or faulty, then posts and hardware shall be utilized from the sign assemblies removed and disposed. All costs for the replacement of damaged or faulty hardware and/or posts shall be included in this item of work.

T.15.03.7 Street Signs. Street sign blade dimension, and text sizes, shall be as follows:

a. Height and Letter Sizes. All faces with 6-inch caps and 4-inch suffix copy will trim to a 9-inch height and shall be used for highways with posted speeds of 40 mph or more, unless otherwise noted.

All faces with 4-inch caps and 2-inch suffix copy will trim to a 6-inch height and shall be used for highways with posted speeds of 35 mph or less, unless otherwise noted.

All street signs mounted overhead will have 8-inch caps and 5-inch suffix caps, and will be 18 inches in height, regardless of posted speed.

All suffix copy shall be placed directly to the upper right hand of the street name designation.

b. Length and Letter Series. Pre-screened street name sign faces in 30, 36, 42, and 48-inch lengths for capital legend will be in accordance with the following guidelines:

The majority of pre-screened faces will be 30 inches or 36 inches in length, and the legends shall be "D" series letters unless otherwise authorized by the Engineer.

If legends in the "D" series letter size have a primary copy of 6 inches and are of such lengths as to require faces longer than 36 inches, the "C" series letter size shall be used, and the sign shall be made to the shortest of the allowable sizes (i.e., 36 inches, 42 inches, or 48 inches).

If legends in the "D" series letter size have a primary copy of 4 inches and are of such lengths as to require faces longer than 30 inches, the "C" series or "B" series letter size (the boldest which space allows) shall be used, and the sign shall be made to the shortest of the allowable sizes (i.e., 30 inches, 36 inches or 42 inches).

Overhead mounted sign blades shall have a minimum length of 36 inches and a maximum length of 72 inches. Legend shall be series “D.” Spacing may be reduced by up to 25 percent if the text does not fit on the 72-inch sign blade. If the legend exceeds the 72-inch length with the reduction in spacing, then series “C” text may be used. Lateral spacing from the edge of the sign to the edge of the text shall not be less than 8 inches.

T.15.03.8 Parking Signs.

a. Posts. Posts shall be driven to a depth of 4 feet. The post shall be placed such that the sign is at an angle of not less that 30 degrees nor more than 45 degrees with a line parallel to the flow of traffic. The edge of the sign shall be 18 inches from the face of curb unless space does not permit, in which case the edge of sign shall be 12 inches from the face of curb. At no time will the sign be placed closer than 12 inches to the face of curb.

b. Panel. The sign panel shall be attached to the post using two, 5/16-inch by 2½-inch galvanized bolts with two 0.070 washers per bolt.

T.15.03.9 Signs Mounted on Mast Arms. All signs attached to traffic signal mast arms shall include galvanized steel safety chains.

The mounting bracket used for the overhead street signs will be held in place with stainless steel bands and must be adjustable such that the sign blade is perpendicular to the direction of traffic. The mounting shall hold the sign rigidly in place and resist movement in all directions. Sign blades 60 inches and greater in length shall be held in place with two brackets.

T.15.04 METHOD OF MEASUREMENT.

T.15.04.1. Directional, Regulatory, and Warning Signs. "Directional, Regulatory, and Warning Signs" will be measured by the number of square feet actually furnished and installed in accordance with the Plans and/or as directed by the Engineer.

T.15.04.2 Remove and Relocate Signs. "Remove and Relocate Ground Mounted Signs" and "Remove and Relocate Directional, Regulatory and Warning Signs" will be measured by the number of units actually displaced and replaced in accordance with the Plans and/or as directed by the Engineer.

T.15.04.3 Street Sign Assembly. "Street Sign Assembly" will be measured by the number of units actually furnished and installed in accordance with the Plans and/or as directed by the Engineer.

T.15.04.4 Overhead Street Sign. “Overhead Street Sign” will be measured by the number of units actually furnished and installed in accordance with the Plans and/or as directed by the Engineer.

T.15.04.5 Parking Signs. "Parking Signs" will be measured by the number of square feet actually furnished and installed in accordance with the Plans and/or as directed by the Engineer.

T.15.05 BASIS OF PAYMENT.

T.15.05.1 Directional, Regulatory, and Warning Signs. The accepted quantities of "Directional, Regulatory and Warning Signs" will be paid for at the contract unit prices per square foot as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, tools, materials and equipment, including posts, hardware, excavation and backfilling, and all other incidentals required to finish the work, complete in place and accepted by the Engineer.

T.15.05.2 Remove and Relocate Signs. The accepted quantity of "Remove and Relocate Ground Mounted Signs" and "Remove and Relocate Directional, Regulatory and Warning Signs" will be paid for at their respective contract unit prices per each as listed in the Proposal. The prices so-stated shall constitute full and complete compensation for all labor, tools, materials and equipment, including installing stockpiled materials as necessary, and all other incidentals required to finish the work, complete in place and accepted by the Engineer.

T.15.05.3 Street Sign Assembly. The accepted quantity of "Street Sign Assembly" will be paid for at the contract unit price per each as listed in the Proposal. The price so-stated shall constitute full and complete compensation for all labor, tools, materials and equipment, including

post, sign blades (two or more as required), mounting brackets, straps, and all other incidentals required to finish the work, complete in place and accepted by the Engineer.

T.15.05.4 Overhead Street Sign. The accepted quantity of “Overhead Street Sign” will be paid for at the contract unit price per each as listed in the Proposal. The price so-stated shall constitute full and complete compensation for all labor, tools, materials and equipment, including sign blades, mounting hardware, galvanized steel safety chain, and all other incidentals required to finish the work, complete, in place and accepted by the Engineer.

T.15.05.5 Parking Signs. The accepted quantity of "Parking Signs" will be paid for at the contract unit price per square foot as listed in the Proposal. The price so-stated shall constitute full and complete compensation for all labor, materials and equipment, including posts, and hardware, and all other incidentals required to finish the work, complete in place and accepted by the Engineer.

SECTION T.16

GROUND MOUNTED PRIMARY DIRECTIONAL SIGNS

T.16.01 DESCRIPTION. This work consists of ground mounted primary directional signs furnished and installed, including the necessary concrete bases for supporting posts, at the locations indicated on the Plans and/or as directed by the Engineer, all in accordance with these Specifications.

The work also includes furnishing, fabricating, and erecting "Ground Mounted Primary Directional Sign Posts - Steel Breakaway" at locations indicated on the Plans and/or as directed by the Engineer, including all necessary foundations, breakaway couplings, and other required hardware, all in accordance with these Specifications. All work shall conform to the details shown on the standard drawings entitled "Ground Mounted Primary Directional Sign Post on Breakaway Coupling."

T.16.02 MATERIALS. Extruded aluminum sign panels, sign posts, reflective sheeting, text, borders, colors and hardware shall conform to the applicable requirements of **SECTION M.16; SIGNS AND SIGN SUPPORTS**, of these Specifications.

T.16.03 CONSTRUCTION METHODS.

T.16.03.1 Posts. The lengths of the posts may vary from the lengths indicated on the Plans to fit the final designated sign location and accommodate the method of setting. The Contractor is cautioned to take these contingencies into account.

T.16.03.2 Foundations. Foundations shall be constructed of Class A(AE) cast-in-place concrete which conforms to the applicable requirements of **SECTION 601; PORTLAND CEMENT CONCRETE**, of these Specifications.

The Contractor's design for foundations founded on rock or otherwise unsuitable material shall conform to the applicable requirements contained in the most recently published edition of

AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals. A 90 mph wind load shall be the design wind load.

Oversized augured holes shall be filled with concrete to provide good bearing against existing soil or against newly compacted fill. If the wall along the neat lines of earth excavation collapses, the hole shall be filled in and compacted, and then re-excavated to the neat lines of the proposed footing at no additional cost to the State.

T.16.03.3 Sign Panels. The requirements of **Subsections T.15.03.1** through **T.15.03.3** shall apply.

Whenever each sign face comprises two or more pieces or panels of reflective sheeting, the sign face must be carefully matched for color at the time of fabrication in order to provide uniform appearance and brilliance during day and night. Alternate, successive width sections of either sheeting or panels must be reversed and consecutive to insure that corresponding edges of reflective sheeting lie adjacent to each other on the finished sign. Non-conformance may result in non-uniform shading and an undesirable contrast between adjacent widths of applied sheeting which will not be acceptable.

The method of attachment of the extruded aluminum panels to an overhead sign bracket assembly or a ground mounted assembly shall be as follows:

a. Two clips shall be used at each attachment location regardless of the structural shape utilized in the bracket assembly.

b. Center-to-center spacing of locking tabs along the supporting stringer shall not exceed 0.8 of the cantilever overhand of the sign sheets above and below the sign stringers.

c. The maximum length of locking tabs shall not exceed 3 inches; shall not be less than 1 inch in length; and may be varied in increments of ½-inch length to develop proper strength.

d. Locking tabs shall be drilled and tapped to receive 1/4-inch set screws as shown on the Plans.

e. Each locking tab shall be fastened to the reverse side of the sign face by means of two or more threaded aluminum studs welded to the aluminum sign sheets, and studs shall be provided with aluminum nuts to engage the locking tab as shown on the Plans.

f. Fasteners. All fastening to the sign sheets, exclusive of attaching legend and border, shall be done by means of aluminum studs.

T.16.03.4 Locations. The requirements of **Subsection T.15.03.4** shall apply.

T.16.03.5 Shop Drawings. The Contractor will be required to furnish drawings showing arrangements and spacing of texts and indicating colors of texts and reflective sheeting. Signs found not to conform strictly with the "Manual on Uniform Traffic Control Devices" shall be brought into conformance with said manual prior to acceptance at no additional cost to the State.

The shop drawings will show cross sections of the highway in the areas involved, and the dimension, type and positioning of the signs to be mounted.

Within 30 days after award of the Contract, and prior to fabrication, the Contractor shall furnish, in duplicate, for the approval of the Engineer, complete shop drawings or manufacturer's standard specifications and drawings showing the material and design of the structure proposed to be erected, including details of bases and method of attaching signs to the structure.

After investigating the site conditions, the Contractor shall develop shop drawings in accordance with **Subsection 105.02; Plans and Shop Drawings**, of these Specifications. Shop drawings shall be developed for the foundations and structural supports based on details indicated on the Plans.

T.16.03.6 Sign Covering. The Contractor is to cover and keep covered all signs which have been erected until the message on the signs is pertinent to traffic operations at the time. The covering shall be No. 10 duck mildew-proof canvas. No. 2 spur grommets shall be provided on the periphery of the canvas, 9 inches from center to center of grommets, to receive manila rope, having a diameter of 1/4-inch to 5/16-inch, for fitting and attaching the canvas to the sign panel. The canvas shall be dull green in color and have sufficient overlap on the back of sign to be cross-lashed with manila rope to prevent excessive movement and ripping by wind.

T.16.04 METHOD OF MEASUREMENT.

T.16.04.1 Ground Mounted Primary Directional Sign Panels - Extruded Aluminum. "Ground Mounted Primary Directional Sign Panels - Extruded Aluminum" will be measured by the number of square feet actually furnished and installed in accordance with the Plans and/or as directed by the Engineer.

T.16.04.2 Ground Mounted Primary Directional Sign Post - Steel Breakaway. "Ground Mounted Primary Directional Sign Post - Steel Breakaway" will be measured by the number of units actually furnished and installed in accordance with the Plans and/or as directed by the Engineer.

T.16.05 BASIS OF PAYMENT.

T.16.05.1 Ground Mounted Primary Directional Sign Panels - Extruded Aluminum. The accepted quantity of "Ground Mounted Primary Directional Sign Panels - Extruded Aluminum" will be paid for at the contract unit price per square foot as listed in the Proposal. The price so-stated shall constitute full and complete compensation for all labor, tools, materials and equipment, including application of reflective sheeting, exit sign panels, legends, borders, arrows, shields, hardware, sign coverings, and all other incidentals required to finish the work, complete in place and accepted by the Engineer.

T.16.05.2 Ground Mounted Primary Directional Sign Post - Steel Breakaway. The accepted quantities of "Ground Mounted Primary Directional Sign Post - Steel Breakaway" will be paid for at the contract unit price per each as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, tools, materials and equipment, including foundations, breakaway couplings, the restoration of existing ground surfaces and all other incidentals required to finish the work, complete in place and accepted by the Engineer.

SECTION T.17

OVERHEAD SIGN PANELS AND SUPPORTS

T.17.01 DESCRIPTION. This work consists of furnishing, fabricating, transporting, and erecting overhead signs and structures of the type and at the locations indicated on the Plans and/or as directed by the Engineer, all in accordance with these Specifications. The sign structure design shall be furnished by the Contractor with construction contingent upon approval of the Engineer. This work also includes steel overhead sign structures, including concrete bases for supporting columns, extruded aluminum overhead sign panels, and all necessary hardware and attachments required.

T.17.02 MATERIALS. Extruded aluminum sign panels, structural sign supporting members and shapes, reflective sheeting, text, borders, colors, and hardware shall conform to the applicable requirements of **SECTION M.16; SIGNS AND SIGN SUPPORTS**, of these Specifications. Concrete for bases shall be Class A(AE) and shall conform to the applicable requirements of **SECTION 601; PORTLAND CEMENT CONCRETE**, of these Specifications.

T.17.03 CONSTRUCTION METHODS.

T.17.03.1 Sign Design. Each complete sign, which includes sign structure, sign panel, and sign panel supporting frame, shall be designed, fabricated and erected to withstand wind loadings and design stress values as set forth in the latest revision of AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals."

T.17.03.2 Steel Overhead Sign Structure. Prior to the start of fabrication of the overhead sign supports, the Contractor shall, in the field, verify the location of the foundations and establish and verify all elevations, dimensions and longitudinal grades.

All connections using high strength bolts shall conform to the applicable requirements of **SECTION 824; STRUCTURAL STEEL CONSTRUCTION**, of these Specifications.

Prior to assembly, the top and bottom surfaces of the base plate shall be planed, or else the plate shall be hot straightened. The post shall be faced at the bottom end.

The top leveling nuts and the grout leveling template shall be removed prior to placing the base plate and post assembly upon the foundation.

The Overhead Truss Sign Support shall not be painted except that any damaged galvanized areas shall be given two coats of zinc paint conforming to the requirements of the Federal Specification TT-P-641-b(2).

T.17.03.3 Sign Panel. Signs shall be fabricated of extruded aluminum sign panels in accordance with the requirements of **Subsection T.16.03.3** of these Specifications.

T.17.03.4 Shop Drawings. The requirements of **Subsection T.16.03.5** shall apply.

T.17.04 METHOD OF MEASUREMENT.

T.17.04.1 Overhead Sign Panels. "Overhead Sign Panels" will be measured by the number of square feet of panels actually furnished and installed in accordance with the Plans and/or as directed by the Engineer.

T.17.04.2 Overhead Sign Structures. "Overhead Sign Structures" will be measured by the number of such units actually furnished and installed in accordance with the Plans and/or as directed by the Engineer.

T.17.05 BASIS OF PAYMENT.

T.17.05.1 Overhead Sign Panels. The accepted quantity of "Overhead Sign Panels" will be paid for at the contract unit price per square foot, as listed in the Proposal. The price so-stated shall constitute full and complete compensation for all labor, tools, materials and equipment, including reflective sheeting, legend, borders, arrows, exit sign panels, shields, hardware, and all other incidentals required to finish the work, complete in place and accepted by the Engineer.

T.17.05.2 Overhead Sign Structures. The accepted quantity of "Overhead Sign Structures" will be paid for at the contract unit price each as listed in the Proposal. The price so-stated shall constitute full and complete compensation for all labor, tools, materials and equipment, including foundations, hardware, and all other incidentals required to finish the work, complete in place and accepted by the Engineer.

Allowance for rock excavation shall be made for a distance of one foot outside the foundation and 6 inches below the bottom of the foundation, as constructed, and will be measured and paid for as "Trench Excavation - Rock" under the applicable requirements of **SECTION 205; TRENCH EXCAVATION**, of these Specifications.

SECTION T.18

DELINEATORS AND HAZARD MARKERS

T.18.01 DESCRIPTION. This work consists of furnishing and erecting delineators and hazard markers of the type and design as indicated on the Plans and/or as directed by the Engineer, all in accordance with these Specifications. This work also includes the provision of flexible delineator posts.

T.18.02 MATERIALS. Single or multi-reflector delineators, reflectorized sheeting, and posts shall conform to the applicable requirements of **SECTION M.16; SIGNS AND SIGN SUPPORTS**, of these Specifications.

T.18.02.1 Flexible Delineator Posts. The delineators shall be manufactured from a flexible material which meets the following requirements:

a. Height. The overall dimensions of the delineator post shall be such that when installed in accordance with the manufacturer's instructions, the top of the post shall be 48 inches above the final surface.

b. Delineator Posts shall remain flexible at temperatures between 0°F and 140°F and shall be durable, resistant to impact, ultraviolet light, ozone hydrocarbons and other atmospheric weathering. Posts shall be white or yellow in accordance with details indicated on the Plans.

c. Posts may be either a one-piece system or a two-piece system. When a two-piece system is used, the post portion shall be readily replaceable without removing or partially removing, the anchor and without displacing the soil around the anchor.

d. Surfaces. Both the front and back surfaces of the delineator shall be smooth surfaces capable of accepting 3-inch wide reflective sheeting.

T.18.02.2 Sheeting. Reflective sheeting shall be Type III meeting the requirements of **Subsection M.16.02; Reflective Sheeting**, and shall be applied to one or both sides of the post as specified on the Plans. The reflective sheeting shall be 3 inches wide and 3, 6, or 9 inches high. The color of the sheeting shall be white, yellow or red, as specified on the Plans.

T.18.03 CONSTRUCTION METHODS.

T.18.03.1 Delineators. The spacing, placement, type, and color of the delineators shall conform to the latest edition of the "Manual on Uniform Traffic Control Devices." Delineators shall be installed on delineator posts of the size and type indicated on the Plans.

T.18.03.2 Flexible Delineator Posts. One-piece flexible delineator post shall be installed in a pilot hole 1/4" x 4" x 18" deep, seated and tamped to the satisfaction of the Engineer. The pilot hole shall be formed by a hand held pilot hole driver as recommended by the manufacturer. At no time shall a delineator be driven into the ground.

A two-piece system utilizes an anchor which is driven into the ground using a hand or mechanical driver. The post is subsequently attached to the anchor in accordance with the manufacturer's instructions.

T.18.03.3 Hazard Markers. Hazard markers shall consist of groups of reflector units placed as shown or directed. The markers shall be mounted at a height of 4 feet above the pavement, except when applied directly to a hazardous object which by its nature requires higher or lower mounting.

T.18.04 METHOD OF MEASUREMENT. "Delineators", "Flexible Delineator Posts", and "Hazard Markers" will be measured by the number of units of the type or types actually furnished and installed in accordance with the Plans and/or as directed by the Engineer.

T.18.05 BASIS OF PAYMENT. The accepted quantities of "Delineators," "Flexible Delineator Posts," and "Hazard Markers" will be paid for at their respective contract unit prices per each such type, as listed in the Proposal. The prices so-stated constitute full and complete compensation for all labor, tools, materials and equipment, including the reflector units, assembly bolts and

theft-resisting nuts, posts, and all other incidentals required to finish the work, complete in place and accepted by the Engineer. Where required, one-tenth mile station notation shall be included in the price of "Delineators" and/or "Flexible Delineator Posts."

SECTION T.19

MILEPOST MARKERS

T.19.01 DESCRIPTION. This work consists of milepost markers furnished and installed at locations as indicated on the Plans and/or as directed by the Engineer, all in accordance with these Specifications.

T.19.02 MATERIALS. Aluminum sheets, reflective sheeting, sign posts and bolts shall conform to the applicable requirements of **SECTION M.16; SIGN AND SIGN SUPPORTS**, of these Specifications.

T.19.03 CONSTRUCTION METHODS. The post shall be driven into the ground to a depth of 2 feet, utilizing a driving cap to protect the post. The milepost markers are to be attached to the post such that the bottom of the marker is 4 feet above grade.

a. Sign Face. The requirements of **Subsection T.15.03.2** shall apply.

T.19.04 METHOD OF MEASUREMENT. "Milepost Markers" will be measured by the number of units actually installed in accordance with the Plans and/or as directed by the Engineer.

T.19.05 BASIS OF PAYMENT. The accepted quantity of "Milepost Markers" will be paid for at the contract unit price per each as listed in the Proposal. The price so-stated shall constitute full and complete compensation for all labor, tools, materials and equipment, including reflective sheeting, legend, posts, and hardware, and all other incidentals required to finish the work, complete in place and accepted by the Engineer.

SECTION T.20

PAVEMENT MARKINGS

T.20.01 DESCRIPTION. This work consists of furnishing and applying and/or removing the following items of pavement marking, at the width, and locations indicated on the Plans, all in accordance with these Specifications.

a. Waterborne pavement markings.
b. Thermoplastic pavement markings.
c. Epoxy resin pavement markings.

d. Bi-directional control devices.
e. Temporary reflectorized pavement markings (tape).
f. Temporary fast drying waterborne pavement markings.
g. Removal of existing pavement markings.

T.20.02 MATERIALS. Composition, binder, pigments, thermoplastic compound pavement marking material, reflective glass spheres, and epoxy resin marking material shall conform to the applicable requirements of **SECTION M.17; PAVEMENT MARKINGS**, of these Specifications.

T.20.03 CONSTRUCTION METHODS.

T.20.03.1 Cleaning Pavement. All dirty pavements shall be swept or air blasted clean. The piles of dirt obtained by sweeping shall be picked up and disposed of by the Contractor.

Oil, grease, and similar adherent matter shall be removed by washing with a suitable solvent. Excess solvent shall be wiped from the pavement and allowed to evaporate before applying pavement marking material.

The Contractor shall be responsible for all pavement cleaning which may be required. Markings shall not be applied to any surface which has not been inspected and approved by the Engineer.

T.20.03.2 Defective Work. Unsatisfactory markings, resulting from the presence of dirt, oil, grease, scale, moisture, or other foreign substances, and all other traffic markings rejected by the Engineer shall be obliterated by a method approved by the Engineer and replaced by the Contractor at its own expense.

T.20.03.3 Waterborne Pavement Markings.

a. Condition in Container. The paint as received shall show no livering, skinning, mold growth, corrosion of the container, or hard settling of the pigment. Any settling shall be readily dispersed when stirred by hand with no persistent foaming.

b. Packaging. Containers must be either rust resistant (e.g., stainless steel or coated with a good quality epoxy or phenoxy clear coating) 30-gallon open-head drums with drum lever lock, or ring and bolts, with rust resistant cover; or 250-gallon rust-resistant moveable totes. Drums should be tight-filled and have a floating polyethylene lid liner in contact with the paint surface.

Containers and lids should be white or off-white on the outside to avoid excessive heat build-up when sitting in sunlight.

c. Sampling/Inspection. The paint manufacturer shall submit to the Department two, one-quart samples of the paint along with a batch formula in weight proportions and total gallons per batch prior to the award of the bid. The formula shall be in generic terms rather than trade names. After the paint has been manufactured, a one-quart sample along with the batch analysis shall be submitted to the Department's Materials Section, Two Capitol Hill, Room 018, Providence, RI 02903.

Field samples should be sealed tightly immediately upon sampling and submitted to the Materials Testing Laboratory within 72 hours for laboratory testing.

d. Installation. The paint must be reflectorized for night visibility by adding glass beads before the paint dries or sets by using drop-on or pressurized methods. The glass beads shall be evenly dispersed on a wet paint film of 14 - 16 mils (110-115 square feet per gallon) at a rate of 6 pounds per gallon.

The lines shall be applied with airless or air-assisted spray equipment so as to have the paint at a temperature of 150°F maximum in the heat exchanger and between 120° and 140°F at the spray nozzle. The maximum no-tracking time shall not be exceeded when the pavement temperature is greater than 45°F under humidity conditions of 85 percent or less on dry pavement.

Paint shall be applied in accordance with the requirements of **Subsection T.20.03.5, Para. c; Weather Conditions**, of these Specifications.

T.20.03.4 Temporary Waterborne Pavement Markings. Paint to be used for temporary pavement markings shall conform to the requirements of **Subsection T.20.03.3**, **Paras. a, b, and c**, above.

This paint must be reflectorized for night visibility by adding reflective spheres before the paint dries or sets by using drop-on or pressurized methods. The reflective spheres shall be evenly dispersed on a wet paint film of 8 mils (60 square feet per gallon) at a rate of 3 pounds per gallon.

The Contractor shall schedule temporary pavement markings such that they shall be placed on newly paved roadways which shall be opened to traffic at the completion of each day's paving operations.

T.20.03.5 Thermoplastic Pavement Markings. When thermoplastic pavement markings are specified, the material used shall be a thermoplastic compound, free of volatiles, which is designed for machine application from approved equipment and shall readily extrude at temperatures between 400°F to 425°F to produce a cross section of line 1/8-inch to 3/16-inch thick. After cooling to the ambient temperature and without polymerization or other chemical change, the line shall form a pavement marking continuous and uniform in shape, having a clear and sharp dimension and of the quality and appearance herein specified. The material shall be especially compounded for traffic marking and shall not lose its bond with the pavement when the ambient temperature falls below 32°F.

Reflectorization shall be obtained from approved glass beads conforming to **Subsection M.17.01** of these Specifications.

The application of additional glass beads by the drop-on method shall be at the rate of .08 pounds per square foot of marking.

The pigmented binder shall be well dispersed and free from all skins, dirt, foreign objects or ingredients that will cause bleeding, staining or discoloration due to dissolution of asphalt in the pavement.

After application and drying time, the material shall show no appreciable deformation or discoloration under local traffic conditions and in air and road temperatures ranging from $0^{O}F$ to $120^{O}F$, and shall adhere securely under repeated freezing and thawing.

The stripes shall maintain the original dimensions and placement. The exposed surface shall be free from tack. Cold ductility of the material shall be such as to permit normal movement with the road surface without chipping or cracking in order to prevent dimensional distortion as a result of traffic impact within the temperature range specified. Ability to resist distortion by natural discoloration shall be retained for the life of the stripe.

The compound shall not be deteriorated by contact with sodium chloride, calcium chloride or mild acids, alkalies or other chemicals used against formation of ice on roadways; by oil contained in the pavement material; or by oil drippings from vehicular traffic.

When installed at an air temperature of $70^{O}F$, between 1/8 and 3/16-inch thick, composition shall be completely solid and shall show no effect of tracking after 15 minutes.

Equipment must be provided to insure removal of dust, debris, and other foreign matter from the road surface immediately prior to the installation of the pavement marking.

Thermoplastic applicating equipment shall be approved by the Engineer prior to the start of work.

For heating the thermoplastic composition, the application equipment shall include a melting kettle(s) of such capacity as to allow for continuous marking operations.

Application equipment shall be constructed to provide continuous mixing and agitation of the material. Conveying parts of the equipment between the main material reservoir and the extrusion shoe(s) shall be so constructed as to prevent accumulation and clogging. All parts of the equipment which come into contact with the material shall be so constructed as to be easily accessible and exposable for cleaning and maintenance. The equipment shall be constructed so that all mixing and conveying parts, up to and including the extrusion shoe(s), maintain the material at the required plastic temperature.

The applicating equipment shall be so constructed as to insure continuous uniformity in the dimensions of the stripe. The applicator shall provide a means for cleanly cutting off stripe ends squarely and shall provide a method of applying "skip" lines. The equipment shall be capable of applying varying widths of traffic markings.

The applicator shall be equipped with a drop-on type bead dispenser capable of uniformly dispensing reflective glass spheres at controlled rates of flow.

The bead dispenser shall be automatically operated in such a manner that it will only dispense beads while the composition is being applied. The bead dispenser shall be positioned so that the beads will be applied no more than 6 inches behind the molten thermoplastic.

Applicating equipment shall be mobile and maneuverable to the extent that straight lines can be followed and normal curves can be made in a true arc.

The equipment used for the placement of thermoplastic pavement markings shall be two general types: mobile applicator and portable applicator.

a. Mobile Applicating Equipment. The mobile applicator shall be defined as a truck-mounted, self-contained pavement marking machine that is capable of hot applying thermoplastic by the extrusion method. The unit shall be equipped to apply the thermoplastic material at temperatures of from 440°F to 425°F, at the widths and thicknesses specified herein.

Ribbon and spray methods are prohibited.

The mobile unit shall be equipped with an extrusion shoe(s), and shall be capable of marking edgeline and centerline stripes. The extrusion shoe(s) which shall be so constructed that the 4th side of the extrusion consists of the pavement itself, shall be closed, heat jacketed or a suitably insulated unit; shall hold the molten thermoplastic at a temperature of from 400°F to 440°F; and shall be capable of extruding a line of from 3-to-8 inches in width, and at a thickness of not less than 1/8-inch nor more than 3/16-inch, and of generally uniform cross section. Material temperature gauges shall be affixed or incorporated in the extrusion shoe in such a manner as to be visible, and capable of monitoring the composition temperature throughout the marking operation.

The mobile unit shall be equipped with an electronic and programmable line pattern control system, or mechanical control system, so as to be capable of applying skip or solid lines in any sequence, and through any extrusion shoe in any cycle length.

b. Portable Applicating Equipment. The portable applicator shall be defined as hand operated equipment, specifically designed for placing thermoplastic installations such as crosswalks, stop bars, legends, arrows, and short lengths of lane, edge and centerlines. The portable applicator shall be capable of applying thermoplastic pavement markings by the extrusion method. It is intended that the portable applicator will be loaded with hot thermoplastic composition from the melting kettle(s). The portable applicator shall be equipped with all the necessary components, including a materials storage reservoir, bead dispenser, extrusion shoe, and heating accessories, so as to be capable of holding the molten thermoplastic at a temperature of from 400°F to 440°F, of extruding a line of from 3-to-12 inches in width, and in thickness of not less than 1/8-inch nor more than 3/16-inch in thickness, and of generally uniform cross section. Material temperature gauges such as a probe type or a remote reading infrared thermometer shall be affixed or incorporated in the extrusion shoe in such a manner as to be visible and capable of monitoring the composition temperature throughout the marking operation.

c. Weather Conditions. Thermoplastic pavement markings shall be placed upon dry pavement surfaces. At the time of installation, the pavement surface temperature shall be a minimum of 50°F and rising.

1. Option. In the event that the surface temperature is 45°F and rising, the Contractor may choose to apply thermoplastic pavement marking material provided that the surface is dry and the Contractor accepts all responsibility for the performance of the thermoplastic line striping for a period of one year from the date of application. The Contractor shall submit his request in writing to the Engineer for approval. Replacement of any thermoplastic material which fails for any reason during this one-year period shall be replaced by the Contractor at its own expense.

No payment will be made for that quantity of material placed at surface temperatures below 50°F for the period of one year.

T.20.03.6 Epoxy Resin Pavement Markings

a. Equipment. Equipment for the application of epoxy resin traffic stripes or special handwork shall consist of one or more mobile, truck-mounted and self-contained pavement marking machines, specifically designed to apply epoxy resin striping material and reflective glass beads in continuous and skip-line patterns. The equipment shall be capable of applying straight and curved lines in a true arc. In addition, the truck-mounted unit shall be provided with accessories to allow for the marking of legends, symbols, crosswalks, and other special patterns. At any time throughout the duration of the project, the Contractor shall provide free access to the equipment for inspection by the Engineer. The Engineer may approve the use of a portable applicator in lieu of mobile truck-mounted accessories for use in applying special markings only, provided such equipment can demonstrate satisfactory application of reflectorized epoxy markings in accordance with these Specifications.

The application equipment shall be capable of installing a minimum of 10 miles of epoxy reflectorized pavement markings in an eight hour day and shall include the following features:

1. Individual material reservoirs for the storage of each of the components and each type of glass beads.

2. Heating element of sufficient capacity to maintain the individual epoxy resin components at the manufacturer's recommended temperature for spray application.

3. Two separate gravity type glass beads dispensers capable of uniformly applying glass beads to epoxy resin traffic stripes at the rate required.

4. Accurately calibrated, tamper-proof, metering type devices to monitor the ratio of the components being fed to the spray nozzle. The devices should be visible to the operator while the equipment is in use and can be capable of displaying the proportioning such that the actual mixing ratio can be determined at all times.

5. Accurately calibrated, tamper-proof, metering type devices that measure and record the number of gallons of epoxy resin material used and corresponding length of stripe(s) applied. Each application gun shall have individual footage accumulators which are activated only when material is being applied. This information shall be provided in a format that permits a direct determination of the yield (average mil thickness) of the applied materials.

6. All applicator guns on the spray carriages shall be in full view of the operator during operation. The equipment shall be capable of placing two lines simultaneously with either line a solid or intermittent pattern in yellow or white. When the color of the material is changed, a quantity of material equal to 150 linear feet of stripe(s) shall be wasted to eliminate the chance of contamination of the alternate color.

7. An air pressure nozzle directed to the area to be striped to permit cleaning of the road surface immediately prior to application of the material. The pressure in the line shall be a minimum of 175 psi.

8. When working on a roadway with more than one lane in either direction, the applicator truck shall have a permanently mounted, variable direction, illuminated arrow board, fully operational and visible to approaching traffic.

b. General. Before any pavement marking work is begun, a schedule of operations shall be submitted for the approval of the Engineer. At least 5days prior to starting striping, the Contractor shall provide the Engineer with the epoxy manufacturer's written instructions for use, including but not limited to, material mixing rations and application temperatures.

When pavement markings are applied under traffic flow conditions, the Contractor shall provide all necessary signs, cones, arrow boards, etc., in accordance with the contract provisions and the latest edition of the MUTCD to maintain and protect the traffic, the marking operation, and the pavement markings until thoroughly set.

The application of pavement markings shall be performed in the general direction of traffic. Striping against the flow of traffic will not be allowed.

If, for any reason, it is not possible to place epoxy lane and center lines within the guidelines and restrictions of the contract, and no previous lines exist, the Contractor, at his expense, shall place the appropriate color of four-inch reflective temporary pavement markings for the entire length of the roadway that is unstriped in accordance with the latest edition of the MUTCD. The temporary pavement markings and possible subsequent removal shall be at the Contractor's expense. The type of temporary markings will be approved by the Engineer.

The Contractor shall be responsible for removing, to the satisfaction of the Engineer, all tracking marks, spilled epoxy, and epoxy markings applied in unauthorized areas.

c. Test Strip and Calibration. Prior to the start of striping operations, one or more test strips shall be constructed. Each test strip shall consist of approximately 100 linear feet of pavement with white and yellow striping (lane and edgeline) similar to that required for the project. The purpose of the test strip(s) is to demonstrate the capability of the proposed epoxy resin striping material, the equipment and procedures to place epoxy resin traffic stripes that comply with these Specifications including, but not limited to, retroreflectivity, dimensions, appearance (uniform color and crisp, well-defined edges), wet film thickness, drying time and glass bead quantity, application and retention. When the test strips are in compliance, the Contractor will be permitted to proceed with the striping operations.

A test strip shall be required for each applicator unit used. Additional test strips may be required when major equipment repairs or adjustments are made, or at any time requested by the Engineer.

d. Procedures. The road surface shall be cleaned and free from all dirt, oil, grease and other foreign material, including curing compound on new Portland cement concrete, immediately prior to the striping operation. New epoxy markings may be applied over worn, well-bonded epoxy if approved by the Engineer; all others, such as (but not limited to) thermoplastic, tape, and newly striped paint will be removed as follows and as approved by the Engineer:

1. Grinding. Markings shall be removed to a minimum of 95 percent of their surface area. The method shall not damage the surface in any way and have no more than a moderate color and/or texture change. The grinding truck must be capable of removing 80,000 linear feet of 6-inch line per day; and must be equipped with a vacuum and dust collector that is 99.99 percent efficient in removing particles no bigger than 0.5 microns. Any pavement markings removed must be replaced within 1 day. Removal is at no extra cost. A sweeper with the

capacity to pick up grindings simultaneously with the removal operation is required. If the Contract eliminates grinding of material, power washing remains a requirement.

2. Power Wash. All special patterns, handwork, and oil or other deleterious substances shall be removed by a power wash machine with a pressure of 2400-2800 psi with the water heated to 180-195°F. No chemicals shall be added to the water in the process. The machine will be equipped with a turbo blast tip with oscillating head and shall be capable of supplying 5 gallon/minute/gun.

Pavement cleaning shall consist of at least a brushing with a rotary, non-metallic broom and additionally as may be recommended by the material manufacturer, all to the satisfaction of the Engineer. New Portland cement concrete shall be cleaned by sandblasting to remove any surface treatments and/or laitance. Surface cleaning and preparation work shall be performed only in the area of the epoxy markings applications. The pavement surface shall be air-blasted to remove dirt and residues just prior to the application of the markings.

e. Restrictions. Epoxy striping material shall be applied to substantially dry pavement surfaces. The pavement surface temperature and the ambient temperature shall be a minimum of 35°F at time of application. Operations shall neither start nor be continued during periods of rain or in the case of damp pavement. Operations shall not continue until the Engineer determines that the roadway surface is dry enough to achieve adhesion.

The individual epoxy components shall be heated to the temperatures recommended in the epoxy manufacturer's written instructions for use or as stated in the FHWA Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects (note maximum temperature of 140°F).

The ratio of the two components shall be monitored during the application, using the installed metering devices. Should the ratio fall outside the range of ±5 percent of the manufacturer's specified mixing ratio for over 30 seconds or at any time fall outside the range of ±10 percent, the application shall be stopped and the cause of the problem determined and corrected before proceeding.

f. Application. Epoxy pavement markings must be reflectorized for night visibility by adding reflective spheres before the paint dries or sets, by the double-drop method. The reflective spheres, Type I followed immediately by Type II, shall be evenly dispersed on a minimum wet film thickness of 20 mils on existing and new pavements at a minimum rate of 12 pounds per gallon for each type of glass sphere. All special patterns and handwork (i.e., stop bars, arrows, legends, symbols, etc.) shall meet the above application rates with the following exception: The double-drop application of glass spheres will use the Type II gradation only with two applications at a minimum of 12 pounds per gallon each.

The Contractor shall place necessary spotting at appropriate points to provide horizontal control for striping and to determine necessary starting and stopping points. Longitudinal joints, pavement edges and existing markings shall serve as horizontal control when approved by the Engineer.

Epoxy reflectorized pavement markings shall be placed at the width, thickness, and pattern designated by the Contract Documents. Marking operations shall not begin until applicable surface preparation work is completed and approved by the Engineer, and the

atmospheric conditions and pavement surface temperature are acceptable to the Engineer. The temperature of the mixed epoxy may be adjusted as required for prevailing conditions, including air temperature and pavement temperature to achieve the prescribed no-track time. The speed of the applicator truck shall not exceed the recommended rate for the combination of the truck rate, pressure in the lines, and the tip opening and height of the spray gun to insure the required thickness.

g. Quality Assurance. A tolerance of 1/4-inch under or over the specified width will be allowed for striping provided the variation is gradual and does not detract from the general appearance. Alignment deviations for the control guide shall not exceed 2 inches provided the variation is gradual and does not detract from the general appearance. Material shall not be applied over a longitudinal joint. Establishment of these tolerances shall not relieve the Contractor of his responsibility to comply as closely as practicable with the planned dimensions.

Retroreflection shall be measured using a 30-meter geometry portable unit following ASTM D6359 with the following exceptions: minimum values shall not be less than 350 mcd/lum/m2 for white and 225 mcd/lum/m2 for yellow as measured by the Engineer; and measurement for acceptance shall be performed between 14 and 60 days after placement.

Epoxy reflectorized pavement markings, which after application and curing are determined by the Engineer to be defective and not in conformance with this Specification, shall be repaired. Repair of defective markings shall be the responsibility of the Contractor and shall be performed to the satisfaction of the Engineer at no additional cost to the State. Repair methods shall be detailed and submitted for approval to the Engineer prior to corrective action.

T.20.03.7 Symbols and Word Messages. Symbols and word messages shall be applied to the pavement where designated on the Plans or as directed by the Engineer. The letters shall be elongated in the direction of traffic as shown on the Plans or as directed by the Engineer.

T.20.03.8 Bi-directional Control Device. The Raised Reflective Pavement Markings (RRPMs) and thermoplastic shall be applied according to the method indicated in the respective requirements of these Specifications for each item, and as detailed on the Plans.

T.20.04 METHOD OF MEASUREMENT. "Waterborne Pavement Markings," "Thermoplastic Pavement Markings," “Epoxy Resin Pavement Markings,” “Temporary Fast-Drying Waterborne Pavement Markings,” ”Temporary Pavement Markings (Tape)," and "Remove Existing Pavement Markings" will be measured by the number of linear feet (excluding skips and spaces) actually installed or removed, as the case may be, in accordance with the Plans and/or as directed by the Engineer.

The following items will be measured by the number of each such unit actually furnished and installed in accordance with the Plans and/or as directed by the Engineer.

- Waterborne Pavement Arrow - Straight Left, Right or Combined
- Waterborne Pavement Marking Word "ONLY"
- Waterborne Pavement Marking Word "STOP"
- Thermoplastic Straight Arrow
- Thermoplastic Left/Right Arrow
- Thermoplastic Combined Arrow

- Thermoplastic Marking Word "ONLY"
- Thermoplastic Marking Word "STOP"
- Bi-directional Control Device
- Epoxy Resin Pavement Arrow - Straight, Left, Right or Combined
- Epoxy Resin Pavement Marking Word “ONLY”
- Epoxy Resin Pavement Marking Word “STOP”

In certain cases, any or all of the items of work may be paid for on a lump sum basis. In such cases, no measurement is required.

T.20.05 BASIS OF PAYMENT. The accepted quantity of "Pavement Markings" will be paid for at their respective contract unit prices per linear foot, per each; or by lump sum; for each type or types, as listed in the Proposal. The prices so-stated shall constitute full and complete compensation for all labor, tools, materials and equipment, including protection of newly applied markings from traffic, layout, cleaning and sweeping, furnishing and applying the pavement markings, and all other incidentals required to finish the work, complete in place and accepted by the Engineer.

T.20.05.1 Epoxy Retroreflection Values. Payment shall be as follows:

a. Minimum 350 / 225 (white/yellow): 100% contract unit price.
b. Minimum 330 / 205 (white/yellow): 90% contract unit price.
c. Minimum 310 / 185 (white/yellow): 80% contract unit price.
d. Minimum 300 / 175 (white/yellow): 75% contract unit price.
e. Below 300 / 175 (white/yellow): 0% contract unit price.

T.20.05.2 The accepted quantity of “Temporary Pavement Markings (Tape)” will be paid for at the contract unit price per linear foot for each type or types as listed in the Proposal. The price so-stated shall constitute full and complete compensation for all labor, tools, materials, and equipment, including protection of newly applied markings, cleaning and sweeping pavement, applying pavement markings and removal of pavement markings when no longer in use, and all other incidentals required to finish the work, complete in place and accepted by the Engineer. Fifty percent of the contract bid price will be paid at the time of installation and 50 percent upon removal of such markings.

SECTION T.21

TEMPORARY CONSTRUCTION ZONE REFLECTIVE PAVEMENT DELINEATORS

T.21.01 DESCRIPTION. This work consists of furnishing, placing, maintaining, and removing construction zone reflective pavement delineators at the locations indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

T.21.02 MATERIALS. The delineator shall consist of a shell and lens molded of Methyl Methacrylate, conforming to Federal Spec. LD 380C, Type 1, Class 3. The shell shall reflect incident light for traffic flow in a singular direction. Dimensions are to be at least 4" x 4" and a

minimum reflective area of 0.38 square inches in each reflective face. The delineators must be installed using the bituminous adhesive that must conform with the delineator manufacturer's requirements and specifications.

T.21.03 CONSTRUCTION METHODS. The delineators shall be placed on bridges or lane shifts. At the time of installation, the pavement surface must be clean and dry so that it will not impair the adhesion. Prior to installation of the delineators, the adhesive must be heated to the temperature determined by the manufacturer. The delineator must be applied with quick pressure to insure proper adhesion to the pavement surface. The reflective faces must be placed perpendicular to the line of traffic flow.

T.21.04 METHOD OF MEASUREMENT. "Temporary Construction Zone Reflective Pavement Delineators" will be measured by the number of such units actually furnished and installed in accordance with the Plans and/or as directed by the Engineer.

T.21.05 BASIS OF PAYMENT. The accepted quantity of "Temporary Construction Zone Reflective Pavement Delineators" will be paid for at the contract unit price per each as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials and equipment including surface cleaning, bituminous adhesive and all other incidentals required to finish the work, complete, in place and accepted by the Engineer.

If in the opinion of the Engineer any delineator fails to perform satisfactorily, such delineator shall be replaced by the Contractor at no additional cost to the State. Moreover, any damage to the finished pavement surface; any permanent marks or scars on the finished pavement surface, including marking materials, or any adhesive residues left in a pattern that may mislead or misdirect traffic that results from removal of delineators shall be removed or repaired as directed by, and to the satisfaction of the Engineer, all at no additional cost to the State. If necessary, this would include complete removal and/or replacement of the damaged pavement section.

SECTION T.22

LIGHTING FOR NIGHT WORK OPERATIONS

T.22.01 DESCRIPTION. This work consists of illuminating work zone and lane drop areas, and all other areas within which are located channelization devices placed along the roadway for the purpose of directing or restricting traffic, all as required for night work operations. Illumination of these areas will be provided by both floodlighting and equipment-mounted lighting.

T.22.02 MATERIALS.

T.22.02.1 Floodlights. All floodlights for both the lane drop areas and the equipment mounted lighting shall have cut-off type light distribution and shall have a die-cast aluminum housing with integrally-case heavy-duty hinges. Fixture housing door shall be closed with two or more captive

screws and shall have positive gasketing to insure water tightness and dust tightness. The housing shall have no weep holes. The reflector shall be high purity anodized aluminum with a secondary internal reflector element to reflect high angle rays back into the beam to achieve high beam utilization and meet IES definition of cut-off distribution.

a. Lamp Sockets shall have pre-wire grip-type mogul base with additional support on the glass gasketed to the fixture housing. Ballast shall be pre-wired regulating type designed for -20°F starting with an operating lamp current crest factor not exceeding 1.65. Mounting shall be accomplished with a die-cast aluminum slipfitter designed for a 2-inch tenon. Surface mounting brackets shall be provided for alternate mounting at the Contractor's option. Fixture shall be U.L. listed. Lamps shall be metal halide of the wattage specified.

b. Flourescent Fixtures shall be twin-lamp 4-foot long fixtures utilizing two high-output cool-white flourescent lamps (F48T12/CW/HO). Housing shall be extruded aluminum with high gloss baked white enamel finish. Lens shall be either tempered glass, polycarbonate or virgin acrylic and shall be fully framed and gasketed. Lens frame shall be hinged or captive latched on one side and shall be toggle-latched on the other side with a stainless steel spring loaded bail to apply constant pressure between the lens and fixture housing. All fasteners shall be stainless steel. The lamp holder shall be self-sealing, self-aligning and spring loaded. Lens unlatching and lamp removal shall be accomplished without the use of special tools.

The fixtures shall have integral, high power factor ballasts capable of starting to -20°F. Fixtures shall have fittings for standard continuous row mounting and shall have top-mounting brackets for additional support. Approval shall be obtained from the Engineer prior to the purchase or rental of any lighting fixtures.

T.22.03 CONSTRUCTION METHODS.

T.22.03.1 Plan of Operation. Prior to proceeding with any night work, the Contractor shall submit a plan of night work operations, including placement of illumination devices, to the Engineer for review and approval.

T.22.03.2 Illumination Standards. The following standards shall be maintained at all times during night operations.

a. Lane Drops. The traveled way within the lane drop areas and all cones, barrels, or other physical barriers placed on the roadway for the purpose of channelizing or restricting vehicular traffic shall be illuminated to a minimum average of 2 footcandles measured on both the horizontal and vertical planes 6 inches above the surface in question. The lane drop areas to be illuminated shall be defined as beginning at the first cone, barrel or other physical channelizing device, continuing through the full roadway width transition area, and ending where the traveled way attains the constant width which will be maintained through the construction area. A uniformity ratio average to minimum to one, or better shall be maintained at all times within the illuminated transition area. All portable lighting shall be located off the traveled way opposite the channelizing devices (i.e., when closing the left or high speed lanes, all lighting should be placed on the right side of roadway). All lighting shall be aimed in such a manner to avoid shadows on the traveled way and prevent excessive glare to the motorist. Illumination of the lane drop areas shall be accomplished using 250-watt, 400-watt, 1,000- watt metal halide floodlights in any combination and any number necessary to achieve the footcandle levels and

uniformity ratios specified above. All floodlights shall have flat tempered glass or polycarbonate lenses securely fastened to the housing to prevent personal injury in the event of lamp breakage. Floodlights shall be mounted on portable or fixed poles, tripods or staging in a location off the traveled way. The lighting staging area shall be roped off to all personnel except the lighting technicians.

All generator and wiring shall be within the restricted area and shall conform to all applicable electrical codes and pertinent OSHA safety standards.

T.22.03.3 Equipment Lighting.

a. Rollers. Each roller shall be equipped with a 2-unit light cluster on both the front and back. A single cluster with 2 units (one wide beam and one narrow beam) aimed towards the front is to be used. All floodlights shall be securely mounted to minimize vibrations during roller operations. Floodlights should be mounted on steel bullhorn style brackets with 2-inch tenons and a 36-inch spread. Mounting height shall be a minimum of 8 inches above the top platform surface of the roller, provided the overall height from ground level does not exceed 15 feet. Mounting height and placement shall be designed to allow the operator to run the roller from a standing position without blocking the lighting beams onto the roadway. Floodlights for the roller shall be 250-watt metal halide fixtures as described below.

b. Trucks. A minimum of two pickup trucks equipped with floodlights shall be provided by the Contractor. Each truck shall have a minimum of three (1 wide beam and 2 narrow beams) 250-watt metal halide floodlights mounted on supports on the pickup truck bed. The floodlights shall be aimed in a forward direction over the truck cab but shall also have the capability of being adjusted and aimed in any direction, if required. Floodlights for truck mounting shall be as described below.

c. Pavers. Single width (12-foot nominal) and double width (24-foot nominal) pavers shall be equipped with a continuous twin lamp flourescent bar consisting of enclosed 4-foot flourescent fixtures mounted end to end across the full width of the screed area. Fixtures shall be adjustable so that they may be tilted toward the work area. A minimum of 10 footcandles must be provided at the screed area and in the area (minimum 15 feet) immediately behind the screed where manual raking operations are taking place. Two auxiliary floodlights (narrow beam) shall be provided, one to illuminate guide line and one to illuminate the auger area. Care shall be taken in the placement of these floodlights to avoid aiming of the lights into the line of sight or into the mirrors of trucks which are backing into the auger/hopper area to unload bituminous concrete. Floodlights for the pavers shall be as described below.

d. Equipment Mounting. Mounting shall be designed and constructed by the Contractor at his option to suit the configuration of the equipment to which the lighting is attached. Mounting heights, placement and aiming shall be as hereinbefore described. Mounting shall be secure to prevent excessive vibration and to insure there is no hazard to equipment operators or other personnel. Care shall be exercised to insure that fixture mounting will clear all overhead structures. Lighting configurations for the equipment lighting may, with the concurrence of the Engineer, vary from those specified herein provided that the specified light output is adhered to. All equipment lighting shall be aimed in such a manner as to maximize the illumination on each individual task.

T.22.03.4 Lighting Equipment Schedule.

Location	No. of Fixtures	Size	Type	Remarks
Lane Drop Area	Varies	Varies	Metal halide	Min. fc.
Rollers	4	250w	Metal halide	Aim 2 forward & 2 back
Pickup Trucks	3	250w	Metal halide	Variable aiming
Pavers (single width)	3	48"	Twin lamp flourescent	Screed area
	2	250w	Metal halide	Auger & guide line
Pavers (double width)	6	48"	Twin lamp flourescent	Screed area
	2	250w	Metal halide	Auger & guide line

a. Spare Parts. An inventory of spare lamps and spare fixtures shall be maintained on the job site by the Contractor and all lamp or fixture failures shall be repaired or replaced immediately.

T.22.03.5 Power Sources. The Contractor shall provide portable generators of type, size, and wattage output required to adequately energize the lighting equipment specified. Generator placement and wiring shall be in compliance with all applicable electrical codes and pertinent OSHA safety standards. It shall be the Contractor's responsibility to insure that lighting fixture and generator electrical rating are compatible.

T.22.03.6 Inspection. The illumination on the project shall be monitored at random intervals for conformance to the specifications set forth herein. Substandard illumination in any area (traveled way, work area or equipment lighting) may be sufficient reason for the Engineer to direct stoppage of all work until the substandard situation is corrected.

If there are sufficient noncompliance incidents relating to the illumination of the work area and the lane drops (e.g., failure to maintain the minimum light levels and the uniformity ratios specified, as determined by field tests), or if the finished roadway surface is unsatisfactory in any way, or if safety considerations dictate, the Engineer, at his discretion, may revoke the night-time paving operation for the Contract. The Contractor shall have no claim for loss of anticipated profit because of any such revocation.

The Contractor shall furnish the Engineer, for the duration of the project and at no additional compensation, a hand-held digital light meter, complete with instructions, capable of measuring 1-to-100 footcandles. The light meter is to be returned to the Contractor upon completion of the project.

T.22.04 METHOD OF MEASUREMENT. "Lighting for Night Work Operations" will not be measured separately for payment.

T.22.05 BASIS OF PAYMENT. Provision of “Lighting for Night Work Operations” will not be paid for separately, but shall be considered a subsidiary obligation of the Contractor, with the cost of said lighting distributed among the contract unit prices for those items of work that are to be performed during night-time operations. These unit prices shall include full and complete compensation for furnishing and operating all equipment, labor and materials necessary to illuminate the roadway surface (lane drop and work zone area) including necessary lighting on the equipment and all other incidentals necessary to complete the work of this item as previously specified and to the satisfaction of the Engineer.

PART L

LANDSCAPING

SECTION L.01

LOAM, PLANTABLE SOIL OR HIGH ORGANIC SOIL

L.01.01 DESCRIPTION.

L.01.01.1 Loam. This work consists of placing loam to the lines, grades, and depths shown on the Plans or as directed by the Engineer, all in accordance with these Specifications. The loam shall be furnished by the Contractor from sources outside the project limits (Loam Furnished and Spread).

L.01.01.2 Plantable Soil. This work consists of furnishing and placing plantable soil to a 4-inch depth on designated areas in close conformity to the lines and grades as shown on the Plans or as directed by the Engineer. Plantable soil shall be either furnished by the Contractor from sources outside the project limits, "Plantable Soil Furnished and Spread," or material removed and stockpiled by the Contractor under the excavation items, "Plantable Soil Rehandled and Spread."

L.01.01.3 High Organic Soil. This work consists of furnishing and placing high organic soil to the lines, grades, and depths in detention ponds, wetland replacement and/or wetlands restoration/reclamation areas, as specified herein, as shown on the Plans or as directed by the Engineer. High organic soil shall be either furnished by the Contractor from sources outside the project limits, "High Organic Soil Furnished and Spread," or material removed and stockpiled by the Contractor under the excavation items, "High Organic Soil Rehandled and Spread."

L.01.02 MATERIALS. Loam, Plantable Soil and High Organic Soil shall be clean and free of any undesirable material and conform to the applicable requirements of **SECTION M.18; LANDSCAPING MATERIALS.**

L.01.03 CONSTRUCTION METHODS.

L.01.03.1 Loam. The Contractor shall submit a sample for testing prior to the placement of loam. The sample will be taken from material furnished by the Contractor or from the removed and stockpiled material on site. The sample shall be approved by the Engineer prior to the placement. Loam which does not meet the requirements specified in **SECTION M.18; LANDSCAPING MATERIALS,** shall be rejected.

Prior to the placement of loam the Contractor shall prepare the surface to receive the loam. All roots, sod, weeds, cobbles or stone with any dimension greater than 1 inch shall be removed and legally disposed of.

Loam shall be placed on surfaces which are true to the lines, grades, and cross-sections shown on the Plans or established by the Engineer. Loam shall be placed and spread to the required depth; the minimum thickness shall be as indicated on the Plans and/or in the Proposal.

The loamed surface shall be graded, and all roots, sods, weeds, cobbles or stones with any dimension greater than 1 inch shall be removed and legally disposed of. After shaping and grading, all trucks and other equipment not required to perform seeding, mulching or mowing operations shall be excluded from the loamed areas.

Work under this item shall be performed only with the permission of the Engineer. The Engineer may suspend work when he determines soil or weather conditions are unsuitable for spreading and/or grading loam. The Contractor may resume work when directed by the Engineer.

All loamed areas shall be seeded no more than two weeks after spreading the loam. Refer to **SECTION L.02; SEEDING,** for dates and other requirements. Loamed areas shall be maintained, free from erosion until acceptance of the project.

L.01.03.2 Plantable Soil. The Contractor shall place plantable soil in accordance with **Subsection L.01.03.1**, above.

When items for both "Plantable Soil Rehandled and Spread" and "Plantable Soil Furnished and Spread" appear in the Contract, the Contractor shall complete the placing of all plantable soil available on the project before proceeding to obtain plantable soil from outside sources to the extent feasible in the construction sequence.

L.01.03.3 High Organic Soil. The Contractor shall submit a sample for testing prior to the placement of High Organic Soil. The sample shall be approved by the Engineer prior to placement. High Organic Soil which does not meet the requirements specified in **SECTION M.18; LANDSCAPING MATERIALS,** shall be rejected.

High Organic Soil shall be placed on surfaces which are true to the lines, grades, and cross sections shown on the Plans or established by the Engineer. The depth and location of High Organic Soil shall be as shown on the Plans. All slopes shall be tracked with a dozer. The resulting tracks shall be perpendicular to the flow of water. All roots, sods, weeds, cobbles or stones with any dimension greater than 4 inches shall be removed from the soil surface and legally disposed of. No raking will be permitted.

When items for both "High Organic Soil Rehandled and Spread" and "High Organic Soil Furnished and Spread" appear in the Contract, the Contractor shall complete the placing of all high organic soil available on the project before proceeding to obtain high organic soil from outside sources to the extent feasible in the construction sequence.

The Contractor shall apply a wetland seed mix immediately after spreading and tracking the High Organic Soil. Refer to **SECTION L.02; SEEDING,** for dates and other requirements.

L.01.04 METHOD OF MEASUREMENT.

L.01.04.1 Loam. "Loam" will be measured by the number of square yards, surface measurement, of the area on which the placing of loam has been installed in accordance with the Plans and/or as directed by the Engineer.

L.01.04.2 Plantable Soil. "Plantable Soil" will be measured by the number of square yards, surface measurement, of the area on which the placing of plantable soil has been installed in accordance with the Plans and/or as directed by the Engineer.

L.01.04.3 High Organic Soil. "High Organic Soil" will be measured by the number of square yards, surface measurement, of the area on which the placing of high organic soil has been installed in accordance with the Plans and/or as directed by the Engineer.

L.01.05 BASIS OF PAYMENT.

L.01.05.1 Loam Furnished and Spread. The accepted quantity of "Loam Furnished and Spread" will be paid for at the contract unit price per square yard 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. The loam shall be furnished by the Contractor from sources outside of the project limits.

L.01.05.2 Plantable Soil Furnished and Spread. The accepted quantity of "Plantable Soil" will be paid for at the contract unit price per square yard 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. The plantable soil shall be furnished by the Contractor from sources outside the project limits.

L.01.05.3 High Organic Soil Four Inches (4") Deep (Slopes). The accepted quantity of "High Organic Soil Four Inches (4") Deep (Slopes)" shall be paid for at the contract unit price per square yard 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. The High Organic Soil shall be furnished by the Contractor from sources outside the project limits.

L.01.05.4 High Organic Soil Six Inches (6") Deep (Bottom). The accepted quantity of "High Organic Soil Six Inches (6") Deep (Bottom)" shall be paid for at the contract unit price per square yard 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. The High Organic Soil shall be furnished by the Contractor from sources outside the project limits.

SECTION L.02

SEEDING

L.02.01 DESCRIPTION. This work consists of the preparation of the seed bed, furnishing and placing materials, and the establishing of grassed areas as shown on the Plans, in accordance with these Specifications or as directed by the Engineer. Work shall consist of the following six types:

Type 1. Plantable Soil areas, either flats, to be seeded with a Park Seed Mix or slopes, to be seeded with a Slope Seed Mix;

Type 2. Loamed areas adjacent to lawns or sidewalks, seeded with a Residential Seed Mix;

Type 3. Temporary seeding using a Temporary Seed Mix on sloped and flat areas of embankments or excavation sites, to provide temporary vegetative cover for erodible soils;

Type 4. Plantable Soil areas, either flats or slopes, seeded with a Native Seed Mix;

Type 5. Wetland Areas and High Organic Soil, seeded with a Wetland Seed Mix;

Type 6. Plantable Soil areas, either flats or slopes seeded with a Wildflower Seed Mix.

Slope areas shall be defined as being 3:1 or greater.

L.02.02 MATERIALS. Lime, fertilizer, mulch, water and seed mixtures shall conform to the applicable requirements of **SECTION M.18; LANDSCAPING MATERIALS**.

L.02.03 CONSTRUCTION METHODS.

L.02.03.1 Seeding Dates. Full advantage shall be taken of time and weather conditions best suited for seeding. The normal dates for seeding shall be as follows:

Type 1, Type 2, and Type 4 dates shall be:

Spring Seeding:	April 1 to May 31.
Fall Seeding:	August 15 to October 15.

Type 3 seeding may be done at anytime between March 15 and November 15 with approval of the Engineer. Type 3 seeding shall not be permitted on frozen ground.

Type 5 seeding dates shall be as follows:

Spring Seeding:	May 1 to June 15
Fall Seeding:	August 15 to September 30

Type 6 seeding dates shall be as follows:

Spring Seeding:	April 1 to May 1
Fall Seeding:	September 1 to September 30

Seeding at other than the above time will be allowed only with the written permission of the Engineer. The Engineer may suspend work when he/she determines that soil or weather conditions are unsuitable for raking and/or seeding. The Contractor may resume work when directed by the Engineer.

The Contractor shall notify the Engineer at least 48 hours in advance of the time intended for commencement of seeding. No payment will be made for work performed when the Engineer is not present. In cases where there is existing or new plant material, care shall be taken to insure that no lime, fertilizer, mulch and/or seed mix comes in contact with the plant material or their mulched areas.

L.02.03.2 Preparation of Areas for Seeding.

a. Type 1 (General Highway Seeding). Type 1 areas shall be raked, either by hand or mechanically (i.e. power rake), so as to produce a loose, friable seed bed. Slopes 3:1 and greater shall be tracked with a dozer. The resulting track imprints shall be perpendicular to the flow of water.

All sticks, litter, wire, weeds, cable, cobbles or stones larger than 1 inch in any dimension shall be removed and legally disposed of.

Where the seed bed has become compacted, it shall be scarified to a depth of 5 inches prior to raking. No seeding of this type will be permitted on areas where the seed bed has not been properly prepared or where the soil is compacted.

b. Type 2 (Residential Seeding). Type 2 areas shall be hand raked to a finished grade. All sticks, litter, wire, weeds, cable, cobbles and stones larger than ½-inch in any dimension shall be removed and legally disposed of. After hand raking, and at the discretion of the Engineer, the Contractor shall roll, with a hand roller, the entire area. The finish grade of the proposed area shall blend into the adjacent lawns (when applicable).

Where the seed bed has become compacted, it shall be scarified to a depth of 5 inches prior to fine raking. No seeding of this type will be permitted on areas where the seed bed has not been properly prepared or where the soil is compacted.

c. Type 3 (Temporary Seeding). Type 3 areas to be seeded shall be free of depressions and unprotected channels where runoff may cause erosion.

d. Type 4 (Native Grass Seeding). Type 4 areas shall be prepared in accordance with **Para. a**, above.

e. Type 5 (Wetland Seeding). Type 5 areas shall not be raked. All sticks, litter, wire, weeds, cable, cobbles or stones larger than 4 inches in any dimension shall be removed and legally disposed of without disturbing the finish grade.

f. Type 6 (Wildflower Seeding). Type 6 areas shall be prepared in accordance with **Para. a**, above, except as designated below.

Type 6 areas previously seeded or having existing vegetation shall have all sod removed from the site proposed for wildflower seeding. Plantable soil, as designated on the Plans or as directed by the Engineer, shall be applied to raise the planting bed to final grade (after sod removal). Areas shall be raked to produce a loose friable soil.

L.02.03.3 Application of Lime. Lime (ground or pelletized) shall be applied dry and spread evenly over the entire surface to be seeded. Unless otherwise specified, the application rate shall be 1 ton per acre. Raking shall be completed after the fertilizer has been applied. NO LIME WILL BE APPLIED ON TYPE 3, TYPE 4, AND TYPE 5 AREAS.

L.02.03.4 Application of Fertilizer. After the application of lime, fertilizer shall be spread at the following rates:

Type 1 and 2 -	Eight hundred-fifty pounds (850 lbs.) per acre.
Type 3 -	Six hundred-fifty pounds (650 lbs.) per acre.
Type 4 -	Five hundred pounds (500 lbs.) per acre.
Type 5 -	No fertilizer shall be applied.
Type 6 -	One hundred-fifty pounds (150 lbs.) per acre.

Both the lime and fertilizer shall be thoroughly incorporated into the soil by raking. Raking shall be in accordance with the applicable requirements of **Subsection L.02.03.2**, above.

L.02.03.5 Sowing of Seed. After the seed beds have been prepared as outlined in **Subsections L.02.03.2** through **L.02.03.4**, above, grass seed conforming to the respective formula specified in **Subsection M.18.10; Seed Mixtures**, shall be applied according to the specified rates. Application of fertilizer, grass seed, and cellulose fiber mulch for Type 1, Type 2, Type 3, Type 4, Type 5, and Type 6 may be accomplished in one operation by the use of a hydroseeder.

a. Type 1 (General Highway Seeding). Type 1 areas shall be seeded with Park Mix on flats and with Slope Seed Mix on slopes. Both mechanical and hydroseeding methods may be used.

b. Type 2 (Residential Seeding). Type 2 areas shall be seeded with a Residential Seed Mix. Additional hand raking and rolling with a light roller shall be employed in lieu of mulch. Such areas will not be accepted until a generally weed-free, 3-inch stand of grass is established.

c. Type 3 (Temporary Seeding). Type 3 areas shall be seeded with a Temporary Seed Mix on flats and slopes. Both mechanical and hydroseeding methods may be used.

d. Type 4 (Native Grass Seeding). Type 4 areas shall be seeded with a Native Seed Mix. Both mechanical and hydroseeding methods may be used.

e. Type 5 (Wetland Seeding). Type 5 areas shall be seeded with a Wetland Seed Mix. In areas where there is access for a hydroseeder, the Wetland Seed Mix shall be spread using

this method only. In areas where there is no access for a hydroseeder, the wetland seed mix shall be spread by a hand held spreader.

f. Type 6 (Wildflower Seeding). Type 6 areas shall be seeded with a Wildflower Seed Mix. Seeds may be mechanically applied by overseeding the area with a slit seeder or broadcast with the use of a drop or broadcast spreader. A hydroseeder may be used. When hydroseeding method is used, the seed, fertilizer, and 10 percent of the mulch shall be used in the first application followed by the remaining 90 percent of mulch to be used in a second application.

If a slit seeder is used, seed disbursement shall be 3 inches on center and 1/4-inch deep. Two passes, the second perpendicular to the first shall be made. Small seeds shall be seeded separately from larger seed.

If a drop or broadcast seeding method is used, large seed shall be spread separately from small seeds. Each seed type (large or small) disbursement shall be applied in two passes, the second perpendicular to the first. The area shall be hand raked to provide a soil coverage of a 1/4-inch.

L.02.03.6 Mulching. All seeded areas shall be covered with a suitable mulch at the time of the application of the seed. Unless otherwise specified, cellulose fiber mulch shall be used. Cellulose fiber mulch shall conform to **Subsection M.18.07.1** of these Specifications.

Cellulose fiber mulch may be employed separately or as part of a hydroseeding operation. If cellulose fiber mulch is applied separately, it shall be applied immediately after the seeding operation.

Cellulose fiber mulch that becomes adhered to signs, sign posts, lighting standards, new or existing plant materials and/or walls shall be removed.

L.02.03.7 Care During Construction. Any areas which fail to show a uniform growth of grass for any reason whatsoever shall be reseeded until the areas are covered with a satisfactory growth of grass as approved by the Engineer.

The seed, fertilizer, etc. used in the reseeding operations shall be at the same application rates and during appropriate seeding dates as those previously specified unless otherwise directed by the Engineer.

a. Watering. The Contractor shall water all Type 1, Type 2, Type 4, and Type 6 seeded areas within 72 hours of the seeding operation. One additional watering may be required and such will be at the discretion of the Engineer.

Water shall be applied at a controlled rate and in such a manner to insure the water reaches the root zone. Watering operations shall not flood adjacent areas, erode soil or cause any damage to the seeded areas.

b. Mowing. Mowing for Type 1 seeded areas shall be accomplished in two mowings per year on areas flatter than 3:1. Mowing on Type 2 seeded areas shall be performed when the grass has obtained a height of 4 inches and shall be maintained at a 4-inch height until accepted.

Mowing will be performed for Type 1 and Type 2 only.

Each cutting shall result in a stand of evenly mowed grass, 3 inches tall immediately following the cutting. Neat trimming shall be necessary around all poles, trees, ledges, delineators, curbs, piers, abutments and other structures falling within the seeded areas; this trimming will be conducted simultaneously with the mowing during each cutting operation. All curbs shall be trimmed and exposed; all gutters will be left free of all grass clippings.

c. Failure to Perform Care During Construction. If the Engineer decides that the Care During Construction tasks as specified in the Contract have not been performed, the daily charge set forth in **Special Provision Code L.02.1000** will be deducted from monies due the Contractor as a charge for failure to comply with this Specification. The daily charge will continue each consecutive calendar day until the deficiencies have been corrected to the satisfaction of the Engineer.

L.02.04 METHOD OF MEASUREMENT. "Seeding" will be measured by the number of square yards actually seeded in accordance with the Plans, and/or as directed by the Engineer.

L.02.05 BASIS OF PAYMENT. The accepted quantity of "Seeding" will be paid for at the contract unit price per square yard as listed in the Proposal. The price so-stated constitutes full and complete compensation for preparation of seed beds, for furnishing and applying all lime, fertilizer, mulch, seed, raking, mowing, watering, and care during construction of the seeded areas, for all labor, materials and equipment, and for all incidentals required to finish the work, complete and accepted by the Engineer.

Payment for all types shall be made as follows:

Eighty-five percent of the total contract price will be paid at the time of initial seeding. The remainder, 15 percent, will be paid when the newly seeded areas have been accepted.

If seeding is done at a time other than the specified seeding date, the entire payment for seeding will be withheld until a uniform acceptable stand of turf, as determined by the Engineer, has been obtained.

SECTION L.03

SODDING

L.03.01 DESCRIPTION. This work consists of the preparation of the sod bed and of furnishing, placing and caring for sod as indicated on the Plans, in accordance with these Specifications or as directed by the Engineer.

L.03.02 MATERIALS. Sod, lime, fertilizer, water, and wooden pegs shall conform to the applicable requirements of **SECTION M.18; LANDSCAPING MATERIALS**.

L.03.03 CONSTRUCTION METHODS.

L.03.03.1 Sodding Dates. The dates for sodding shall be as follows:

Spring Sodding:	April 1 to June 30
Fall Sodding:	August 15 to November 15

Sodding shall not be performed on frozen ground nor shall frozen sod be placed.

The Contractor shall notify the Engineer at least 48 hours in advance of the time intended for commencement of sodding. In cases where there is existing or new plant material, care shall be taken to insure that no lime or fertilizer comes in contact with the plant material or their mulched areas.

L.03.03.2 Shipping, Handling, Storage, & Delivery. Sod loads shall be covered at all times during shipment and during delivery to the project site. Sod shall be protected from weather or other damaging and/or deteriorating conditions while in transit or in storage. Any sod which has been damaged or has deteriorated in transit or storage will not be accepted and shall be removed from the project.

Sod shall be harvested, delivered, and installed within a period of 36 hours. Sod not installed within this time period will not be accepted and must be removed from the project.

L.03.03.3 Preparation of the Sod Bed. Sod shall be placed on a minimum of 4 inches of loam or plantable soil. The top surface of the sod shall meet specified grades, or be flush with surrounding finished grades and/or structures.

The sod bed shall be hand raked to produce a loose, friable surface. All sticks, litter, wire, weeds, cable, cobbles or stones larger than ½-inch in any dimension shall be removed and legally disposed of. After hand raking, the Contractor shall roll the entire area with a hand roller.

Where the sod bed has been compacted, it shall be scarified to a minimum depth of 5 inches prior to fine raking. No sodding will be permitted on areas where the sod bed has not been properly prepared or where the soil has become compacted.

L.03.03.4 Application of Lime. Lime (ground or pelletized) shall be applied dry and spread evenly over the entire surface to be sodded. Unless otherwise specified, the application rate shall be 1 ton per acre. Raking shall be completed after the fertilizer has been applied.

L.03.03.5 Application of Fertilizer. After the application of lime, fertilizer shall be spread at the rate of 500 pounds of fertilizer per acre on both flats and slopes.

Both the lime and fertilizer shall be thoroughly incorporated into the soil by raking. Unless otherwise approved, sod areas shall be raked by hand only.

L.03.03.6 Placing of Sod. The sod bed shall be moist. A watering truck shall be on site at all times during the sodding operation. Sod to be placed in drainage ways and in cases where continuous or solid sodding is called for on the Plans, shall be laid with the longest dimension parallel to the contours. Special care shall be taken in forming finish grades at junctions of drainage ways.

The first row of sod shall be laid in a straight line with subsequent rows placed parallel to and tightly against each other. Lateral/vertical joints shall be staggered by a minimum of 12 inches to promote uniform growth and strength. Only full size sod strips shall be used unless otherwise directed by the Engineer. Care shall be exercised to insure that the sod is not stretched or overlapped and that all joints are butted tight.

Immediately after the sod is placed, it shall be pressed firmly into contact with the sod bed by tamping, hand rolling, or by other methods approved by the Engineer. This procedure shall not displace or deform the sod. The Contractor shall cut the sod to the line indicated on the Plans or as directed by the Engineer.

L.03.03.7 Pegging. Sods shall be held in place by approved pegs in all drainage ways, on all slopes 2:1 or steeper and elsewhere as shown on the Plans or as directed by the Engineer. This shall be completed immediately following rolling. At least one peg shall secure each such sod strip, but in no case shall pegs be more than 2 feet apart. Pegs shall have a flat side parallel to the slope and be driven flush with the root crown.

L.03.03.8 Watering. Immediately following installation, sodded areas shall be thoroughly watered.

a. First Week. Watering shall be performed daily during the first week, unless otherwise directed by the Engineer. The watering rate shall be 5 gallons per square yard (24,200 gallons per acre).

b. Second through Fourth Week. Water sod every third day or as directed by Engineer. The watering rate shall be 5 gallons per square yard (24,200 gallons per acre).

L.03.03.9 Joint Dressing. As soon as practical following the initial watering but in every case prior to the second watering, the entire area shall be examined by the Contractor for open joints or other signs of surface imperfection. All open joints or other voids shall be carefully filled with loam or plantable soil.

L.03.03.10 Care During Construction. The Contractor shall maintain the sodded areas including watering and mowing, until all newly sodded areas have been accepted. Prior to acceptance of the work, any damaged areas shall be reshaped, refertilized, resodded or repaired according to these Specifications to the satisfaction of the Engineer with no additional compensation to be made therefore.

a. Mowing. Mowing shall be performed when the grass has obtained a height of 4 inches and shall be maintained at a 4-inch height until accepted.

Each cutting shall result in a stand of evenly mowed grass, 3 inches tall immediately following the cutting. Neat trimming shall be necessary around all poles, trees, ledges, delineators, curbs, piers, abutments, and other structures falling within the seeded areas; this trimming will be conducted simultaneously with the mowing during each cutting operation. All curbs shall be trimmed and exposed; all gutters will be left free of all grass clippings.

b. Failure to Perform Care During Construction. If the Engineer decides that the Care During Construction tasks as specified in the Contract have not been performed, the daily charge set forth in **Special Provision Code L.03.1000** will be deducted from monies due the Contractor as a charge for failure to comply with this Specification. The daily charge will continue each consecutive calendar day until the deficiencies noted have been corrected to the satisfaction of the Engineer.

L.03.04 METHOD OF MEASUREMENT. "Sodding" will be measured by the number of square yards actually installed in accordance with the Plans, and/or as directed by the Engineer.

L.03.05 BASIS OF PAYMENT. The accepted quantity of "Sodding" will be paid for at the contract unit price per square yard as listed in the Proposal. The price so-stated constitutes full and complete compensation for preparation of sod beds, for furnishing and applying all lime, fertilizer, pegs, sod, raking, mowing, watering, care during construction and for all labor, materials and equipment and for all incidentals required to finish the work, complete and accepted by the Engineer.

Eighty-five percent of the total contract price will be paid at the time of the sod installation. The remainder, 15 percent, will be paid when the newly sodded areas have been accepted.

If sodding is done at a time other than specified sodding dates, the entire payment for sodding will be withheld until a uniform acceptable stand of turf as determined by the Engineer, has been obtained. Payment will not be made for work performed when the Engineer is not present.

SECTION L.04

REFERTILIZATION OF SEEDED, SODDED AND GRASSED AREAS

L.04.01 DESCRIPTION. This work consists of a second application of fertilizer to newly seeded and newly sodded areas and/or the application of fertilizer to existing grassed areas, in accordance with these Specifications or as directed by the Engineer.

L.04.02 MATERIALS. The fertilizer applied under this item shall conform to the applicable requirements of **SECTION M.18; LANDSCAPING MATERIALS.**

L.04.03 CONSTRUCTION METHODS. The Contractor shall allow one growing season between the first application of fertilizer to newly seeded areas, as required under **SECTION L.02** and newly sodded areas as required under **SECTION L.03** of these Specifications. The second application is described below:

L.04.03.1 Seeded Areas. The refertilization of seeded areas shall be spread at the following rates:

Type 1 and 2 -	Eight hundred-fifty pounds (850 lbs.) per acre.
Type 3 -	No refertilization is required.
Type 4 -	Two hundred-fifty pounds (250 lbs.) per acre.
Type 5 -	No refertilization is required.
Type 6 -	Seventy-five pounds (75 lbs.) per acre.

L.04.03.2 Sodded Areas. The refertilization of sodded areas shall be spread at the rate of 500 pounds per acre.

L.04.03.3 Existing Grassed Areas. The application of fertilizer to existing grassed areas shall be spread at the rate of 500 pounds per acre.

L.04.04 METHOD OF MEASUREMENT. "Refertilization of Seeded, Sodded and Grassed Areas" will be measured by the number of acres actually fertilized in accordance with the Plans, and/or as directed by the Engineer.

L.04.5 BASIS OF PAYMENT. The accepted quantity of "Refertilization of Seeded, Sodded and Grassed Areas" will be paid for at the contract unit price per acre 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.

SECTION L.05

SEED STABILIZERS

L.05.01 DESCRIPTION. This work consists of furnishing and placing seed stabilizers over seeded areas at locations indicated on the Plans, in accordance with these Specifications or as directed by the Engineer.

L.05.02 MATERIALS. Seed stabilizers shall consist of jute mesh, excelsior matting, erosion control blankets, adhesive mulch stabilizer, and straw mulch. Each such material shall conform to the applicable requirements of **SECTION M.18; LANDSCAPING MATERIALS.**

L.05.03 CONSTRUCTION METHODS.

L.05.03.1 Jute Mesh.

a. General. Jute mesh shall be applied immediately after seeding. The mesh shall be installed loosely but smoothly to fit the contour of the finished grade, parallel to and in the same direction as the surface flow of storm water.

b. Anchor Slots and Junction Slots. The up-slope end of each separate strip or piece of jute mesh shall be buried in a 6-inch minimum vertical anchor slot or junction slot with the soil tamped firmly against the mesh. The Engineer may require that any edge likely to be exposed to greater than normal flow be buried in a similar manner.

c. Check Slots. Check slots shall be spaced so that at least one such slot or junction slot or anchor slot of the jute mesh occurs in each 75 feet on gradients of less than 4 percent, and in each 50 feet on gradients of more than 4 percent. On slope drains, a check slot or an end shall occur every 25 feet.

Check slots shall be formed by folding 1 foot of the jute into a 6-inch vertical slot at right angles to the flow of water. Jute is to be stapled into place, and the surrounding soil is to be firmly tamped at each check slot.

d. Overlap. Where more than one width of material is required, edges shall overlap a minimum of 4 inches; ends at junction slots shall overlap a minimum of 12 inches, and the upslope section of mesh will be on top.

e. Terminal Folds. Down-hill ends of the jute mesh shall be folded under approximately 4 inches and stapled in place.

f. Stapling. Staples will be inserted through the mesh along edges, overlaps, and in the center of all jute mesh strips at intervals not greater than 3 feet. All anchor slots, junction slots, check slots, and terminal folds shall have five staples spaced not more than 9 inches on center across their widths.

g. Over-Seeding. After the jute mesh has been secured in place and immediately prior to rolling, all areas disturbed by installation of the jute mesh shall be over-seeded using the appropriate seed mixture.

h. Maintenance and Repair. The Contractor shall maintain the areas of jute mesh until all work on the project is completed and accepted. Prior to acceptance of the work, if staples have become loosened or raised, or if jute mesh has become loose, torn or undermined by any cause, the damaged areas shall be reshaped, refertilized, reseeded and the jute mesh shall be repaired or replaced according to these Specifications, to the satisfaction of the Engineer and with no additional compensation.

L.05.03.2 Excelsior Matting.

a. General. The areas to receive excelsior matting shall be brought up to the lines and grades indicated, with a smooth surface free of depressions and eroded areas that would allow water to collect or flow under the matting. Applications will be made immediately after seeding; matting shall be applied evenly without stretching and must lie smoothly to fit the contour of the finished grade, parallel to and in the same direction as the surface flow of storm water.

b. Abutting Ends. The adjoining ends shall be butted and where more than one width of material is required they are to be laid parallel to one another with the edges butted snugly.

c. Stapling. The matting shall be held in place by means of staples driven vertically into the soil. Staples shall be spaced not more than 2 feet in three rows for each strip, with one row along each edge and one row spaced 12 inches apart across their width.

d. Maintenance and Repair. The Contractor shall maintain the excelsior matted areas until all work on the entire contract has been completed and accepted. Maintenance shall consist of the repair of areas damaged by erosion, wind, fire, or other causes. Damaged areas shall be repaired to re-establish the condition and grade of the soil prior to application of the matting and shall be reshaped, refertilized, reseeded and the excelsior matting shall be repaired or replaced according to these Specifications, to the satisfaction of the Engineer and with no additional compensation to be made therefore.

L.05.03.3 Erosion Control Blankets. The Contractor shall place erosion control blankets in accordance with **Subsection L.05.03.2;** above.

L.05.03.4 Adhesive Mulch Stabilizer.

a. Preparation. Mixing shall be performed in a tank with a minimum capacity of 500 gallons, with a built-in, continuous agitation or recirculation system of sufficient operating capacity to produce a homogeneous slurry of adhesive mulch stabilizer and water, or adhesive mulch stabilizer, seed, fertilizer, cellulose fiber mulch and water in the designated unit proportions. With the agitation system working at half speed, water shall be added to the tank at the same time as the adhesive mulch stabilizer, and good recirculation shall be established.

Adhesive mulch stabilizer shall be mixed in the proportion of 1 gallon of stabilizer to 5½ gallons of water. A resulting mix of 130 gallons of adhesive mulch stabilizer to 715 gallons of water shall be applied per acre or in accordance with the manufacturer's recommendations. If the manufacturer's recommendations are followed, the Contractor shall provide them to the Engineer for approval, prior to mixing and application. When applicable, seed and fertilizer shall be added when the tank is two-thirds full and shall be batched in accordance with manufacturer's guidelines. Application of the slurry shall commence immediately when the tank is full.

b. Application. The slurry shall be applied in a sweeping motion, at the above specified rate and at which rate which will provide the designated amounts of adhesive mulch stabilizer and when applicable seed, fertilizer and cellulose fiber mulch per acre, in a continuous uniform and even coat. The nozzle shall produce a spray that does not concentrate nor wash down the material.

L.05.03.5 Straw Mulch. Straw shall be applied to seeded areas by hand or blower at the rate of 0.62 to 0.82 pounds per square yard (1½ to 2 tons per acre). The Contractor shall be careful not to distribute straw on to new or existing plant material, pavement surfaces, (driveways, roads, or sidewalks) or other areas not designated on the Plans to receive straw. Straw placed on areas not designated and/or directed by the Engineer shall be removed immediately by the Contractor.

L.05.04 METHOD OF MEASUREMENT.

L.05.04.1 Jute Mesh. "Jute Mesh" will be measured by the number of square yards installed in accordance with the Plans, and/or as directed by the Engineer.

L.05.04.2 Excelsior Matting. "Excelsior Matting" will be measured by the number of square yards installed in accordance with the Plans, and/or as directed by the Engineer.

L.05.04.3 Erosion Control Blanket. "Erosion Control Blanket" will be measured by the number of square yards installed in accordance with the Plans, and/or as directed by the Engineer.

L.05.04.4 Adhesive Mulch Stabilizer. "Adhesive Mulch Stabilizer" will be measured by the number of acres installed in accordance with the Plans, and/or as directed by the Engineer.

L.05.04.5 Straw Mulch. "Straw Mulch" will be measured by the number of acres installed in accordance with the Plans, and/or as directed by the Engineer.

L.05.05 BASIS OF PAYMENT.

L.05.05.1 Jute Mesh. The accepted quantity of "Jute Mesh" will be paid for at the contract unit price per square yard 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.

L.05.05.2 Excelsior Matting. The accepted quantity of "Excelsior Matting" will be paid for at the contract unit price per square yard 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.

L.05.05.3 Erosion Control Blanket. The accepted quantity of "Erosion Control Blanket" will be paid for at the contract unit price per square yard 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.

L.05.05.4 Adhesive Mulch Stabilizer. The accepted quantity of "Adhesive Mulch Stabilizer" will be paid for at the contract unit price per acre 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.

L.05.05.5 Straw Mulch. The accepted quantity of "Straw Mulch" will be paid for at the contract unit price per acre 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.

SECTION L.06

PLANTING

L.06.01 DESCRIPTION. This work consists of furnishing, planting, watering, mulching, staking and guying trees, shrubs, vines, perennials, ornamental grasses, ground covers and bulbs of the type and size as indicated on the Plans, in accordance with these Specifications or as directed by the Engineer.

L.06.02 MATERIALS. Plant materials, antidesiccant, loam, fertilizer, bone meal, mulch, water, stakes, guy webbing fabric, and herbicide shall conform to the applicable requirements of **SECTION M.18; LANDSCAPING MATERIALS.**

L.06.03 CONSTRUCTION METHODS.

L.06.03.1 General. Should the Contractor disturb or damage any areas not shown on the Plans or designated by the Engineer, payment will be withheld until all damaged and/or disturbed areas are repaired with materials equal to or better than that which was existing. This shall include all previously seeded and/or sodded areas.

All work shall be performed under the direct supervision of the Engineer. No payment will be made for work performed when the Engineer is not present.

All persons performing planting or pruning operations shall possess a current Rhode Island Arborist License or be directly supervised by an individual who does. Herbicides shall be applied by only those individuals who possess a current Rhode Island Commercial Applicators License.

L.06.03.2 Planting Dates. All plant material shall be planted during the Spring or Fall planting season as indicated below. No planting shall be performed in frozen ground, or when snow covers the ground. The Engineer may suspend work when he/she determines soil or weather conditions are unsuitable for planting operations. The Contractor may resume work when directed by the Engineer.

a. Balled and Burlapped and Container Material-Deciduous:

Spring: March 1 to June 30
Fall: September 1 to December 15

b. Balled and Burlapped and Container Material – Evergreen (broadleaf and needled):

Spring: April 1 to May 15
Fall: August 15 to October 15

Planting at other than the above time will be allowed only with the written permission of the Engineer. The Engineer may suspend work when he/she determines that the soil or weather conditions are unsuitable for planting. The Contractor may resume work when directed by the Engineer.

Those species known to be Fall Digging Hazards shall be dug during the Spring season only. Fall planting of these species shall be permitted only with certification from the nursery, of the time of digging and shall be at the discretion of the Engineer.

L.06.03.3 Selection, Tagging, Shipment, and Storage. The Engineer shall inspect and tag, at the nursery, all plants proposed for a specific contract. The Contractor shall give 7-days notice to the Engineer prior to any tagging operations. All plant material shall meet the American Association of Nurseryman Standards for Nursery Stock, latest edition and its amendments. Only plants which are hardy to Zone 6 or lower, as determined by the USDA shall be accepted.

APPROVAL OF PLANTS IN THE NURSERY ROW DOES NOT GUARANTEE FINAL ACCEPTANCE IF THE PLANT IS BADLY DUG, DAMAGED IN TRANSIT, POORLY PLANTED, INADEQUATELY MAINTAINED, OR FOR ANY REASON IS IN POOR CONDITION AT THE TIME OF DELIVERY TO THE CONTRACT SITE. ALL PLANT MATERIAL INSPECTIONS AND TAGGING WILL BE MADE AT THE EXPENSE OF THE CONTRACTOR.

All plant materials shall be dug and handled in accordance with the American Association of Nurseryman's Standards for nursery stock, latest editions, and its amendments. All shipments of plant materials by the Contractor shall comply with all nursery inspection and plant quarantine regulations of the states of origin and of destination as well as with the Federal regulations governing the interstate movement of nursery stock. A certificate of inspection shall accompany each package, bale, box or carload lot shipped or otherwise delivered. When more than one variety of a species, or more than one species of a genus is required for a project, each plant or bundle of plants shall be tagged as to variety and/or species prior to delivery to the job site. A certificate of compliance for any or all plant materials shall be required at the time of delivery to the job site.

Plants received by the Contractor shall be kept moist, fresh and protected against exposure to sun, wind and freezing temperatures whether in the receiving yard, in transit, while being handled or in temporary storage on the job site awaiting planting. Balled and burlapped plants shall have their rootballs covered by earth, wood chips, cloth, straw or other suitable material which shall be kept moist.

Plant material shall be covered with a suitable tarpaulin while in transit. Damage to plant material, prior to its acceptance on the job site by the Engineer, shall be the responsibility of the Contractor.

L.06.03.4 Substitution. No substitutes in kinds and size of plant materials will be made without the express written consent of the Department. The Contractor shall notify the Engineer, in writing, regarding requests for plant material substitutions. The Department reserves the right to request the Contractor to submit one letter from each of four different supply sources for plant materials; three sources are to be of the Contractor's selection; one source is to be of the Department's selection. Letters must clearly outline the original plant material(s), the substitute plant material(s) and why the substitution is necessary.

L.06.03.5 Layout and Excavation of Plant Holes. Plant material locations and bed outlines shall be staked on the project site in accordance with the Plans by the Contractor, before any plant pits or beds are excavated. The Contractor shall notify the Engineer at least 24 hours, excluding weekends and holidays, prior to the starting date of layout operations. All staked locations shall be approved by the Engineer prior to the excavation of plant holes. Excavation for planting beds and individual trees shall conform to the approved staked locations and outlines.

Holes dug for planting shall in all cases be large enough to include the complete root system of the plant or tree to be received and also sufficient amounts of approved backfill around the periphery of the root ball. All sod, weeds, roots, cobbles and stones and other objectionable material excavated from the plant holes which is unsuitable for backfill shall be removed from the site immediately and legally disposed of.

The minimum plant hole size, unless otherwise specified, shown on the Plans, or directed by the Engineer, shall be as follows:

a. All Trees and Shrubs (Deciduous and Evergreen). The planting hole shall be twice the diameter of the rootball in width and no deeper than 2 inches less than the distance from the bottom of the rootball to the root collar (i.e. a 12-inch distance between the root collar and bottom of the rootball will require a 10-inch deep hole). Any excavation in excess of that required shall be replaced and compacted to 85 percent of maximum density.

b. Vines, Perennials, Ornamental Grass, and Ground Cover. The planting hole shall be three times the diameter of the rootball in width and equal to the depth from the bottom of the rootball to the level at which it was grown in the nursery. Any excavation in excess of that required shall be replaced and compacted to 85 percent of maximum density.

c. Bulbs. The depth of planting bed for bulbs shall be 2.5 times the bulb(s) diameter (at its widest point) or in accordance with the suppliers' guidelines for individual bulbs species. The width of planting beds shall be as indicated on the Plans or at the direction of the Engineer.

Any rocks or underground obstructions shall be removed to a depth necessary for planting as specified, unless alternate locations for the plantings are approved by the Engineer. If removal of obstructions results in a deeper hole than needed for planting, backfill material shall be added and compacted to 85 percent of maximum density to the correct depth.

L.06.03.6 Planting and Backfilling. All plant material shall be brought to the planting site in a well watered condition. Any dry or dehydrated plant material will not be accepted for planting. All plant material shall be set plumb and at such a level as specified in **Subsection L.06.03.5**, above.

All watering of plant material during the backfilling process shall be completed regardless of weather conditions and shall be waived only with the approval of the Engineer. The Contractor shall, at all times during the planting operation, have a watering truck on site and prepared for watering activities.

a. Balled and Burlapped Trees and Shrubs. Plants shall be handled in such a manner that the soil of the ball will not be loosened from the roots. Carefully place plant into the prepared pits and fill in around the ball to one-half the depth of the hole with loam. Thoroughly tamp the loam to 85 percent of maximum density. Fill remaining area of hole with water. Once water has completely drained loosen burlap and peel down at least the top one third. If wire baskets are used, cut and bend down top third of basket. Roots that have been wrapped around the ball within the burlap shall be made to lay in as natural a manner as possible.

Fill remaining area of hole with loam and thoroughly tamp to 85 percent of maximum density. Form a saucer around the edge of the backfilled hole by constructing a berm. The finish height of the compacted berm shall be 3 inches. No excess soil other than the berm will be allowed to remain within the plant saucer. Fill saucer area with water.

b. Container Grown Trees and Shrubs. Carefully remove the tree and/or shrubs from the container. Over the prepared hole, gently loosen the soil from around the root mass. Roots that are wrapped around the ball within the container shall be made to lay in as natural a manner as possible. Spread root mass out in bottom of prepared hole and sift loam around the root mass to one-half the depth of the hole. Thoroughly tamp the loam to 85 percent of maximum density.

Fill the remaining area of hole with water. Once water has completely drained, fill remaining area of hole with loam and thoroughly tamp to 85 percent of maximum density. Form a saucer around the edge of the backfilled hole by constructing a berm. The finish height of the compacted berm shall be 3 inches. No excess soil including the berm will be allowed to remain within the plant saucer. Fill the saucer area with water.

c. Vines, Perennials, Ornamental Grasses, and Ground Cover. Carefully remove plant from container. Over the prepared hole, gently loosen the soil from around the root mass. Spread root mass out in bottom of the prepared hole and sift loam around the root mass to one-half the depth of the hole. Thoroughly tamp the loam to 85 percent of maximum density. Fill the remaining area of hole with water. Once water has completely drained, fill the remaining area of hole with loam and thoroughly tamp to 85 percent of maximum density. Form a saucer around the edge of the backfilled hole by constructing a berm. The finished height of the compacted berm shall be 3 inches. No excess soil will be allowed to remain within the plant saucer. Fill the saucer area with water.

d. Bulbs. Place bulbs, with the correct side up, into planting bed. Fill around individual bulbs so that loam covers the bottom half of the bulbs. Spread, by hand, bone meal over entire bulb planting bed to a rate not to exceed ½-pound per 25 square feet. Fill the remaining area of the planting bed with loam. Thoroughly tamp the loam to 85 percent of maximum density. Form a saucer around the edge of the backfilled planting bed by constructing a berm. The finish height of the compacted berm shall be 3 inches. No excess soil, including the berm, will be allowed to remain within the plant saucer. Fill saucer area with water. Once the water has completely drained, refill the saucer area with water.

L.06.03.7 Watering. All plant material shall be watered as described in **Subsection L.06.03.6; Planting and Backfilling,** and again within 72 hours. One additional watering may be needed and will be performed at the direction of the Engineer. All watering shall be completed unless otherwise directed by the Engineer. At each watering, the soil around each plant shall be thoroughly saturated.

The following is a guide for minimum requirements:

Trees:
- 2½” Caliper and less - Fifteen (15) gallons each.
- 3” to 5” Caliper - Twenty (20) gallons each.
- 5½” Caliper and above - Twenty-five (25) gallons each.

Shrubs:
- 24” and less - Six (6) gallons each.
- More than 24” - Ten (10) gallons each.

Vines, Perennials, and Ornamental Grasses - Three (3) gallons each.

Groundcovers and Bulbs - Two (2) gallons per square foot.

Water shall be applied at a controlled rate and in such a manner to insure that the water reaches the root zone (saucer) of the plant or plant bed and does not run off to or flood adjacent areas. Watering shall be completed in a manner which does not dislodge plants, erode soil or mulch, or cause damage to the saucer berm. Each saucer of individual plants on planting bed

shall be completely saturated before moving on to the next site. The overhead hydroseeder spray nozzles shall not be used as watering devices. The hydroseeder can be used to transport and store water for watering operations and when a hose and nozzle are properly attached and approved by the Engineer can be used for watering operations.

L.06.03.8 Mulching. Mulch shall be applied after the first watering and no later than one week after planting. All areas to be mulched shall be free of weeds, stones, and other extraneous material.

Prior to the placement of mulch, the Contractor shall apply a pre-emergent weed control around all individual trees, shrubs, and shrub beds, and around all plant material to be mulched. Pre-emergent weed control shall be applied by a Rhode Island Licensed Commercial Applicator at a rate in accordance with the manufacturer's instruction and as approved by the Engineer. Mulch material shall be furnished and placed over all saucer areas of individual trees and shrubs and over the entire area of planting beds as indicated on the Plans or as directed by the Engineer. All mulch material shall be placed, spread, and raked to an even finish surface.

Where mulch abuts seeded or sodded areas, the edge of the planting area (for both individual trees and shrubs and bed areas) shall be cut smooth and clean. Mulch shall be placed carefully so as not to spill into adjacent areas. Any excess or spilled mulch shall be immediately removed.

a. Pine Bark Mulch. Pine Bark Mulch shall be placed to a depth of 3 inches and shall be no closer than 4 inches to the trunk of individual trees and shrubs in accordance with the Plans and these Specifications.

b. Woodchips. Woodchips shall only be used if expressly outlined on the Plans or as directed by the Engineer. Woodchips shall be placed to a depth of 3 inches and shall be no closer than 4 inches to the trunk of individual trees and shrubs in accordance with the Plans and these Specifications.

Prior to the application of woodchip mulch, the Contractor shall top dress all saucer areas for individual trees and shrubs, all shrub and vine beds, all perennials and ornamental grass beds with a 1-1-1 granular fertilizer at a rate of 2 ounces per square foot.

c. Mulching Vines, Perennials and Ornamental Grass. All mulch placed around vines, perennials, and ornamental grass shall be in accordance with the Plans and these Specifications with the exception of its depth. All mulch material (Pine Bark and Woodchips) shall be placed to a depth of 2 inches.

d. Mulching Bulbs. All mulch placed over bulb beds shall be in accordance with the Plans and these Specifications with the exception of its depth. All mulch material (Pine Bark and Woodchips) shall be placed to a depth of 2 inches and shall cover the entire bulb planting bed.

L.06.03.9 Staking and Guying. All stakes shall be set plumb and driven firmly 3 feet into the ground. The above ground stake height shall be no more than 8 inches above the point of attachment of the guy webbing. Two stakes shall be equally spaced around the tree and shall be located outside of the planting pit in undisturbed soil.

Guy webbing shall be attached to both stakes and intertwined at the tree trunk. The guy webbing shall lay flat against the tree trunk; all kinks or wrinkles shall be removed prior to final

attachment. The guy webbing shall be tight enough to remove slack but shall not cause deflection or strain to the plant.

All trees, deciduous and evergreen, shall be staked unless otherwise directed by the Engineer. The guy webbing shall be attached at a point no higher than one-half the height of the tree or lower than one-third the height of the tree. Additional staking may be required and shall be at the discretion of the Engineer.

The guy webbing shall be attached to the stake in a manner that the finish level of the webbing shall be parallel to the ground. Stakes and guy webbing shall present a uniform appearance when installation is complete.

Stakes and guy webbing shall be removed within one year of the installation of the plants unless otherwise directed by the Engineer.

L.06.03.10 Pruning. Pruning of all plants shall be performed by or under the direct supervision of a Rhode Island Licensed Arborist skilled in this work and in accordance with currently accepted horticultural practice. Only broken, dead or injured branches shall be removed. All cuts shall be made parallel to and as close to the branch or stem collar as possible. All cuts shall be made in a manner which prevents damage to the bark. Broken roots shall be pruned on the plant side of the break. The foregoing shall be performed at the time of planting. Die back shall be pruned before final acceptance.

Pruning shall not deform nor destroy the typical shape or symmetry of the plant. The leader of the tree shall not be cut unless directed by the Engineer. All pruning tools shall be disinfected, sharp, and approved by the Engineer.

Tree paint shall not be used on any cuts except on Quercus Species with a cut of 1 inch and greater.

L.06.03.11 Clean-up. All areas disturbed by planting operations shall be left in a clean and orderly condition. Excess soil and rubbish shall be disposed of in a legal, off site location. All grasses or sodded areas disturbed shall be restored to a condition satisfactory to the Engineer but shall be no less than the condition prior to the planting operation. All reseeding or sodding shall be in accordance with **SECTIONS L.02** and **L.03**, respectively, of these Specifications.

L.06.03.12 Antidesiccant Application. Antidesiccant shall be applied to plant material as specified and under the following conditions:

a. Spring Applications. All evergreen and deciduous plant material (trees, shrubs, and vines) planted during the Spring season on exposed and/or windy site or as directed by the Engineer shall receive an application of antidesiccant within ten days after the planting operation. Antidesiccant shall not be applied during periods when the temperature is 90°F or hotter.

b. Fall Applications. All evergreen plant material (trees, shrubs and vines), regardless of time of planting or planted location, shall receive an application of antidesiccant between November 15 and December 15.

All antidesiccant applications shall be in accordance with the manufacturer direction for mixture and temperature range and shall not be applied in the rain. Antidesiccant application shall cover all sides of the leaf or needle.

L.06.03.13 One-Year Establishment Period. All plant material shall receive a One-Year Establishment (Guarantee) Period. During this time, the Contractor shall employ currently accepted horticultural practices to keep all plant material installed in a living, healthy condition up to the date of final acceptance, which shall be one full calendar year following the satisfactory completion of the planting activities as confirmed, in writing, by the Engineer.

During this period, the Contractor shall water, weed, cultivate, prune, mulch and repair, replace or readjust guy webbing and stakes, as may be required or as directed by the Engineer. The Contractor shall reshape plant saucers, repair wash outs and gullies, replace lost mulch, keep all planting sites free from weeds and do other work necessary to maintain the plant material in a healthy, growing condition.

All dead, dying, or rejected plant material, as determined by the Engineer, shall be promptly removed from the project during the period of establishment, and shall be replaced by the Contractor in kind, quantity and size as originally specified, with live, healthy specimens selected and planted in accordance with these Specifications. All replacement plant material shall, from the time of installation, receive a one-year establishment period, in accordance with this Subsection.

a. Failure to Perform One-Year Establishment Period. If the Engineer decides that the One-Year Establishment Period tasks in the Contract have not been adequately performed as specified, the daily charge set forth in **Special Provision Code L.06.1000** will be deducted from monies due the Contractor as a charge for failure to comply with this Specification. Moreover, the stated daily charge will continue each consecutive calendar day thereafter until the deficiencies noted have been corrected to the complete satisfaction of the Engineer.

L.06.04 METHOD OF MEASUREMENT. "Planting" will be measured by the number of each tree, shrub, vine, perennial, ornamental grass, groundcover or bulb of the specified kinds and sizes actually installed in accordance with the Plans, and/or as directed by the Engineer.

L.06.05 BASIS OF PAYMENT. The accepted quantities of "Planting" of the various types will be paid for at the contract unit price per each such type as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials, and equipment, including the one-year establishment period, and all other incidentals required to finish the work, complete and accepted by the Engineer.

SECTION L.07

EXTENDED ESTABLISHMENT PERIOD

L.07.01 DESCRIPTION. This work will supersede the requirements of **Subsection L.06.03.13; One-Year Establishment Period**, of these Specifications. It consists of performing currently accepted horticultural practices to keep all plant material installed in a living, healthy condition up

until the date of final acceptance, which date shall be three full calendar years following the satisfactory completion of the planting activities as confirmed in writing by the Engineer. Any horticultural and/or arboricultural techniques not specified herein must be approved by the Engineer.

All persons acting as forepersons to the Landscape Establishment Crews must have a current Rhode Island Arborist License and Commercial Applicators License and shall be on site at all times during work activities.

L.07.02 MATERIALS. Water, fertilizer, pre-emergent herbicide, mulch, antidesiccants, stakes, guy webbing, and plant material shall conform to the applicable requirements of **SECTION M.18; LANDSCAPING MATERIALS**.

L.07.03 CONSTRUCTION METHODS.

L.07.03.1 General. This work shall consist of the establishment of previously planted trees, shrubs, vines, perennials, ornamental grasses, ground covers, bulbs and wildflowers as shown on the Plans, in accordance with these Specifications and/or at the direction of the Engineer. Establishment tasks shall include, but shall not be limited to, watering, weeding, mulching, fertilization, pruning, mowing and replacement of dead, dying, or rejected plant material.

a. Submittal. The Contractor shall submit to the Engineer, at the start of each year, a schedule of work for establishment activities for that year.

b. Landscape Establishment Crew. The Contractor shall employ one or more Landscape Establishment Crews during the contract period. All crews shall be under the direct supervision of a person who shall possess a current Rhode Island Arborist License. Individual crew members shall be trained in current horticultural practices.

Landscape Establishment Crews shall be responsible for manual and/or mechanical weed control, pruning, inspection and removal of dead or damaged plant material, planting, watering, mulching, and fertilization.

L.07.03.2 Watering. Watering of all plant material shall be performed once every two weeks for a total of thirteen times during each contract year from June 1 through October 31. Wildflower areas shall be watered once a month during each contract year from June 1 through October 31 for a total of five waterings. At each watering, the soil around each plant shall be thoroughly saturated.

The following is a general guide for minimum water requirements:

Trees:
- 2½” Caliper and less – Fifteen (15) gallons each.
- 3” to 5” Caliper – Twenty (20) gallons each.
- 5½” Caliper and above – Twenty-five (25) gallons each.

Shrubs:
- 24” and less – Six (6) gallons each.
- More than 24” – Ten (10) gallons each.

Vines, Perennials, Ornamental Grasses - Three (3) gallons each.

Bulbs and Ground Covers - Two (2) gallons per square foot.

Wildflower Areas - One (1) gallon per square foot.

Water shall be applied at a controlled rate and in such a manner to insure that the water reaches to root zone (saucer) of the plant or plant bed and does not run off to nor flood adjacent areas. Watering shall not dislodge plants, erode soil or mulch or cause damage to the saucer berm. Each saucer or planting bed shall be completely saturated before moving on to the next site. The overhead hydroseeder spray nozzles shall not be used as a watering device. The hydroseeder can be used to transport and store water for watering operations and when a hose and nozzle are properly attached and approved by the Engineer, can be used for watering operations.

All watering shall be completed regardless of weather conditions unless otherwise directed by the Engineer.

L.07.03.3 Mulching. Mulch shall be placed during the second year of the Establishment Period on all individual plants and plant beds, or as directed by the Engineer. Prior to placement, all weeds, stones and other extraneous material shall be removed. The Contractor shall apply pre-emergent weed control around all individual plants and plant beds to be mulched. Pre-emergent weed control shall be applied by Licensed Rhode Island Commercial Applicator and at a rate in accordance with manufacturer's instructions.

The type of mulch (Pine Bark or Woodchips) shall be as specified on the Plans and in accordance with the requirements of **Paras. a and b of Subsection L.06.03.8** of these Specifications. The amount of new mulch shall result in a finish depth of 2 inches of mulch (old and new) or as directed by the Engineer. Wildflower areas shall not be mulched.

L.07.03.4 Fertilization. Fertilizer shall be applied during the first and third year of the establishment period on all individual plants and plant beds or as directed by the Engineer. Fertilization shall occur between April 1 and June 15 only.

Fertilizer shall be broadcast over all individual plants and plant beds at a rate of 1 ounce per square foot. Wildflower areas shall not be fertilized.

L.07.03.5 Weed Control. The Landscape Establishment Crew shall manually remove all weed growth, including grass and litter from individual plants and planting beds. Woody growth, vines and other undesirable volunteers shall be removed and legally disposed of. The Contractor shall remove all woody growth, vines, and litter from wildflower areas. Weed control activities shall be performed in such a manner not to disturb or destroy plant material or mulched areas.

L.07.03.6 Pruning. Pruning of all plants shall be performed in accordance with **Subsection L.06.03.10** of these Specifications.

L.07.03.7 Insect and Disease Control. Periodic inspection of all plantings by trained personnel is necessary to detect problems during early stages of insect infestations or disease infections. Application of all chemicals including insecticides and fungicides shall be carried out in

accordance with Rhode Island State laws and only by individuals with current Rhode Island Pesticide Applicators License and shall be approved of by the Engineer prior to application.

L.07.03.8 Stake and Guy Inspection and Removal. During the first year, any broken stakes and/or guy webbing shall be replaced or repaired.

After the first year, the Contractor shall remove all stakes and guy webbing. The Engineer shall determine individual plants which will have stakes and guy webbing remaining beyond the first year. The Contractor shall remove these stakes and guy webbing only at the request of the Engineer.

L.07.03.9 Inspection, Removal, and Replacement of Dead or Damaged Plant Material. The Contractor shall remove all dead or damaged plant material as determined by the Engineer. Removed material shall be replaced by the Contractor in kind, quantity and size as originally specified, with live, healthy specimens selected and planted in accordance with **SECTION L.06; PLANTING**. All replaced plant material shall be subject to the requirements of this **SECTION L.07** up to, and until the end of this activity.

L.07.03.10 Failure to Perform Extended Establishment Period. If the Engineer decides that the Extended Establishment Period tasks in the Contract have not been adequately performed as specified, the daily charge set forth in **Special Provision Code L.07.1000** will be deducted from monies due the Contractor as a charge for failure to comply with this Specification. Moreover, the stated daily charge will continue each consecutive calendar day thereafter until the deficiencies noted have been corrected to the complete satisfaction of the Engineer.

L.07.04 METHOD OF MEASUREMENT.

L.07.04.1 Extended Establishment Period. The "Extended Establishment Period" shall be measured for payment per month for eight months during the work season in accordance with the Plans and/or as directed by the Engineer.

L.07.04.2 Watering. “Watering” shall be measured for payment per gallon actually installed in accordance with the Plans and/or as directed by the Engineer.

L.07.05 BASIS OF PAYMENT.

L.07.05.1 Extended Establishment Period. The "Extended Establishment Period" shall be paid for at the contract unit price per month, for eight months during the work season as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials and equipments and for all incidentals required to finish the work completed and accepted by the Engineer.

L.07.05.2 Watering. “Watering” shall be paid for at the contract unit price per gallon 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.

SECTION L.08

TREE AND SHRUB TRIMMING

L.08.01 DESCRIPTION.

L.08.01.1 Tree and Shrub Trimming. This work consists of removing and disposing of all dead wood, stubs, broken or damaged branches and stems, undesirable branches and stems from existing trees and shrubs as indicated on the Plans, in accordance with these Specifications or as directed by the Engineer.

L.08.01.2 Tree Trimming for Utilities. This work consists of removing and disposing of all dead wood, stubs, broken or damaged branches and stems, undesirable branches and stems from existing trees for the sole purpose of utility relocation as indicated on the Plans and/or as directed by the Engineer, all in accordance with these Specifications.

L.08.02 MATERIALS. All materials shall conform to the applicable requirements of **SECTION M.18; LANDSCAPING MATERIALS**.

L.08.03 CONSTRUCTION METHODS. All tree and shrub trimming and the trimming for utilities shall be performed in accordance with currently accepted horticultural practice. All trimming shall be performed by or under the direct supervision of a Rhode Island Licensed Arborist.

This work consists of removing and disposing of all dead wood, stubs, broken or damaged branches and stems, undesirable branches and stems from existing trees and shrubs as shown on the Plans and/or as directed by the Engineer. Any and all branches interfering with or hindering the healthy growth of the tree or shrubs shall be removed and disposed of. Any branches which may be partially dead, yet has a healthy lateral branch at least one-third the diameter of the parent branch shall be removed only beyond the healthy branch. All branches interfering with overhead clearance of vehicles or with lines of sight shall be removed as directed.

All cuts shall be made parallel to and as close to the branch or stem collar as possible. All cuts shall be made in a manner which prevents damage to the bark. Pruning shall not deform nor destroy the typical shape or symmetry of the tree or shrub. All cuts shall be made with disinfected, sharp tools which shall be approved by the Engineer.

Tree paint shall not be used on any cuts. The use of climbing irons or other equipment injurious to trees shall not be permitted.

L.08.04 METHOD OF MEASUREMENT.

L.08.04.1 Tree and Shrub Trimming. "Tree and Shrub Trimming" will be measured by the number of manhours actually employed in trimming in accordance with the Plans and/or as directed by the Engineer.

L.08.04.2 Tree Trimming for Utilities. "Tree Trimming for Utilities" will be measured by the number of crew-hours actually employed in trimming in accordance with the Plans and/or as directed by the Engineer.

L.08.05 BASIS OF PAYMENT.

L.08.05.1 Tree and Shrub Trimming. The accepted quantity of "Tree and Shrub Trimming" will be paid for at the contract unit price per manhour 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.

L.08.05.2 Tree Trimming for Utilities. The accepted quantity of "Tree Trimming for Utilities" will be paid for at the contract unit price per crew-hour 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.

SECTION L.09

SELECTIVE CLEARING

L.09.01 DESCRIPTION. This work consists of the removal and legal disposal of trees, shrubs, vines and stumps within the area shown on the Plans, in accordance with these Specifications or as directed by the Engineer.

L.09.02 MATERIALS. Herbicides shall conform to the applicable requirements of **SECTION M.18; LANDSCAPING MATERIALS.**

L.09.03 CONSTRUCTION METHODS. All trees, shrubs, vines and other plant materials to remain shall be designated in the field by the Engineer. The remaining trees, shrubs, vines and stumps shall be cut off flush with ground.

Trunks and branches over 8 inches in caliber shall be stacked as cordwood in 4-foot lengths or disposed of according to **Subsection 201.03.1; Clearing and Grubbing**, of these Specifications. Small branches, leaves, and other refuse, shall be removed and legally disposed of.

All poison ivy, bull briar or other noxious weeds remaining in these areas shall receive a foliar spray of a non-selective herbicide. Application shall be carried out in accordance with the Rhode Island state laws. Non-selective herbicides shall be applied by a Licensed Rhode Island Commercial Applicator in accordance with manufacturer's instructions and shall be approved by the Engineer.

All dead trees shall be removed from the area. Work shall be performed in a manner directed at enhancing the area, and the remaining natural growth shall be left undisturbed.

L.09.04 METHOD OF MEASUREMENT. "Selective Clearing" will be measured by the number of acres and fractions thereof, actually cleared and cleaned up in accordance with the Plans, and/or as directed by the Engineer. The bounds for such acreage shall be established on the ground by flagging or as otherwise directed by the Engineer.

In no case shall an area designated as a "Clearing and Grubbing" area be included in measurements for payment under this item.

L.09.05 BASIS OF PAYMENT. The accepted quantity of "Selective Clearing" will be paid for at the contract unit price per acre 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.

SECTION L.10

TREE AND SHRUB ROOT PRUNING

L.10.01 DESCRIPTION. This work consists of both mechanical and manual pruning of existing tree and shrub roots in order to allow for the installation of new roadway and roadway features without causing extensive damage to the root systems of nearby plant materials. Pruning work shall be as performed at the locations indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

L.10.02 MATERIALS. All materials shall conform to the applicable requirements of **SECTION M.18; LANDSCAPING MATERIALS.**

L.10.03 CONSTRUCTION METHODS. The Contractor shall notify the Engineer 48 hours prior to commencement of this work. All work shall take place in the presence of the Engineer.

L.10.03.1 Pruning Dates. Mechanical and manual tree and shrub pruning shall take place between August 15 and June 15 of the following year.

L.10.03.2 Mechanical Root Pruning. This work shall proceed prior to any excavation work within the project limits. Roots which are found during excavation, outside the designated mechanical root pruning area, may require hand pruning at the discretion of the Engineer.

The machinery to be used shall be a Vermeer CRL-24 Rockwheel, the Vermeer V430A Root Cutter or an approved equal. Trencher equipment shall not be permitted. All hand equipment must be disinfected, sharp, and be approved by the Engineer.

Mechanical root pruning shall take place 6 to 12 inches from the edge of any proposed excavation, or as designated on the Plans. The areas to be pruned will be field located prior to commencement of this item by the Contractor and the Engineer.

The cut made by the specified machinery shall be 2 to 4 inches wide and 15 to 18 inches deep. The length shall be as delineated on the Plans. Paint shall not be used on wounds caused by pruning.

L.10.03.3 Manual Root Pruning. This work shall proceed prior to any excavation work within the project limits. Manual root pruning shall be delineated in the field by the Engineer prior to commencement. However, manual root pruning limits may be extended to other areas at the discretion of the Engineer.

Manual root pruning shall be performed with hand equipment that is disinfected, sharp, and approved by the Engineer.

The Contractor shall carefully hand dig the soil from the delineated area taking care not to rip or otherwise damage the roots during the excavation process. Once located, the root(s) shall be completely exposed, by hand, and cleanly cut using hand pruning equipment.

Pruning shall be performed immediately following the exposure of root(s). After pruning the exposed root(s) shall be covered with existing soil and lightly tamped to remove air pockets. No roots shall be exposed longer than one hour.

L.10.04 METHOD OF MEASUREMENT. "Mechanical Tree and Shrub Root Pruning" and "Manual Tree and Shrub Root Pruning" will be measured by the number of linear feet of each item actually pruned in accordance with the Plans, or as directed by the Engineer.

L.10.05 BASIS OF PAYMENT. The accepted quantities of "Mechanical Tree and Shrub Root Pruning" and "Manual Tree and Shrub Root Pruning" will be paid for at their respective contract unit prices per linear foot as listed in the Proposal. The prices so-stated constitute 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.

No payment will be made for work performed when the Engineer is not present.

SECTION L.11

TREE AND SHRUB PROTECTION DEVICE

L.11.01 DESCRIPTION.

L.11.01.1 Tree Protection Device. This work consists of applying wood framing around the trunk or trunks of the tree from the ground level to the height of 6 feet as indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

L.11.01.2 Shrub Protection Device. This work consists of applying standardized snow fencing around shrubs in a circumferential manner as indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

L.11.01.3 Drip-Line Tree Protection Device. This work shall consist of applying standardized snow fencing around the drip-line of trees in a circumferential manner as indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

L.11.02 MATERIALS.

L.11.02.1 Tree Protection Device. Wood framing shall consist of nominal lumber 6 feet in length; the width and thickness shall vary from 2" x 2" to 2" x 6", depending on trunk diameter. Binding material shall consist of single strand 9-gauge wire or 1/2-inch strapping.

L.11.02.2 Shrub Protection Device. Fencing shall consist of standardized snow fencing. The Contractor shall utilize standard steel posts in maintaining the position of the fencing. The steel post shall be a minimum of 6 feet in length.

L.11.02.3 Drip-Line Tree Protection Device. Materials shall be as indicated above in **Subsection L.11.02.2** for shrub protection devices.

L.11.03 CONSTRUCTION METHODS.

L.11.03.1 Tree Protection Device. The wood framing shall be placed around the trunk in sufficient quantity to protect the trunk from mechanical damage, wood framing members shall not be spaced greater than 4 inches apart. The binding material shall be tight to prevent the wood from moving. The binding material shall not come in contact with the trunk or any portion of the tree. Under no circumstance shall nails or any other type of fastener enter the tree. The wood framing shall be removed and legally disposed of when all mechanical work within the surrounding area has been completed.

L.11.03.2 Shrub Protection Device. The snow fencing shall be placed around the shrub in a circumferential manner assuring a 1-foot clearance between the face of the fence and outer face of the shrub. If a 1-foot clearance is not possible, the fence shall be located as close to the shrub as needed without touching the shrub. The fence shall not be secured to the shrub in any manner. The Contractor shall utilize standard steel posts to support the snow fence. At no time shall restraining lines be secured to the shrub or to surrounding vegetative growth. The fencing shall be removed when all mechanical work within the surrounding areas has been completed.

L.11.03.3 Drip-Line Tree Protection Device. The snow fencing shall be placed around the drip-line of the tree in the same manner as indicated above in **Subsection L.11.03.2** for shrub protection devices.

L.11.04 METHOD OF MEASUREMENT.

L.11.04.1 Tree Protection Device. "Tree Protection Device" will be measured by the number of each such unit actually installed in accordance with the Plans and/or as directed by the Engineer.

L.11.04.2 Shrub Protection Device. "Shrub Protection Device" will be measured by the number of linear feet actually installed in accordance with the Plans and/or as directed by the Engineer.

L.11.04.3 Drip-Line Tree Protection Device. "Drip-Line Tree Protection Device" will be measured by the number of linear feet actually installed in accordance with the Plans and/or as directed by the Engineer.

L.11.05 BASIS OF PAYMENT.

L.11.05.1 Tree Protection Device. The accepted quantity of "Tree Protection Device" will be paid for at the contract unit price per each such unit as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials and equipment, removal and disposal, and for all incidentals required to finish the work, complete and accepted by the Engineer.

L.11.05.2 Shrub Protection Device. The accepted quantity of "Shrub Protection Device" will be paid for at the contract unit price per linear foot as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials and equipment, removal and disposal, and for all incidentals required to finish the work, complete and accepted by the Engineer.

L.11.05.3 Drip-Line Tree Protection Device. The accepted quantity of "Drip-Line Tree Protection Device" will be paid at the contract unit price per linear foot as listed in the Proposal. The price so-stated constitutes full and complete compensation for all labor, materials and equipment, removal and disposal, and for all incidentals required to finish the work, complete and accepted by the Engineer.

SECTION L.12

TREE CUT-OUT PAVING

L.12.01 DESCRIPTION. This work consists of furnishing and installing paving materials (cut granite, granite cobbles, concrete pavers and brick pavers) in tree cut-outs around existing or new trees as indicated on the Plans or as directed by the Engineer, all in accordance with these Specifications.

L.12.02 MATERIALS. Paving material (cut granite, granite cobbles, concrete pavers, brick pavers), landscape filter fabric, and stone fines shall conform to the applicable requirements of **SECTION M.18; LANDSCAPING MATERIALS**.

L.12.03 CONSTRUCTION METHODS.

L.12.03.1 Preparation. Prior to the installation of the landscape filter fabric, the Contractor shall insure that the subbase is at the required depth to accommodate the landscape filter fabric, stone

fines bedding, and proposed paver material to meet the finish grade. The subgrade shall be compacted to 85 percent of maximum density as set forth in **Subsection 202.03.3; Compaction - General**, of these Specifications.

Subgrade irregularities (humps or depressions) greater than 1/4-inch in the line and grade shall be corrected during the installation of the stone fines bedding or by adjusting the subgrade with additional backfill mix.

L.12.03.2 Installation. The Contractor shall install, in two pieces, the landscape filter fabric over the entire tree cut-out area. Each piece shall be cut to allow for the tree trunk. All joints shall overlap by 2 inches. The landscape filter fabric shall be installed in such a manner that the edges, on all sides shall extend vertically, around the perimeter of the tree cut-out to 1 inch of the finish grade.

The stone fines setting bed shall be placed and compacted to a finished thickness of 1 inch. Compaction shall be by a mechanical vibrator resulting in a compaction of 85 percent of maximum density. Once compacted, the top 1/4-inch shall be loosened with a hand rake.

The Contractor shall place the paving material as shown on the Plans. Pavers shall be tamped firmly into the stone fine bedding, and shall meet the required finish grade. Pavers shall be spaced a minimum of 1/8-inch and a maximum of 1/4-inch apart.

Where the geometry of paving area does not allow receiving full size units or pavers require fitting against the edges, the paver shall be cut. All pavers shall be saw cut to straight and even surfaces without chipping. Pavers with chips, cracks and/or irregularities as a result of saw cutting shall not be permitted.

Once the tree cut-out has been paved, the Contractor shall spread a thin layer of stone fine bedding over the paver surface. The stone fine material shall be hosed and/or broomed into the joints between pavers and pavers and trees. Once all joints have been filled, the Contractor shall sweep clean all pavers and surrounding surfaces.

L.12.04 METHOD OF MEASUREMENT. "Tree Cut-Out Paving" will be measured by the number of square feet of such paving actually installed in accordance with the Plans and/or as directed by the Engineer.

L.12.05 BASIS OF PAYMENT. The accepted quantity of "Tree Cut-Out Paving" will be paid for at the contract unit price per square foot 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.

Pavers with chips, cracks, voids, or other defects, shall not be accepted and shall be replaced at the expense of the Contractor.

SECTION L.13

TREE WELLS AND TREE WALLS

L.13.01 DESCRIPTION. This work consists of constructing tree wells in areas where the existing grade is to be filled and tree walls in areas where the existing grade is to be cut. Tree wells and/or tree walls shall be constructed in accordance with the lines and grades shown on the Plans or as directed by the Engineer, all in accordance with these Specifications.

L.13.02 MATERIALS. Stone shall conform to the requirements for stone rubble as set forth in **SECTION M.14; STONE FOR MASONRY**, of these Specifications. The following additions shall also apply:

All new face stones shall match the shape, color, size, texture and geological composition of stones found in adjacent or adjoining walls.

Gravel borrow backfill shall conform to the applicable requirements of **SECTION M.01; BORROW AND AGGREGATES,** of these Specifications.

Mortar shall conform to the requirements of **Subsection M.04.03.5** of these Specifications.

Weep hole pipe shall be Schedule 35 perforated PVC pipe, color gray.

L.13.03 CONSTRUCTION METHODS.

L.13.03.1 Tree Walls. The location of the face of the tree wall shall be measured from the trunk of the tree. This measurement shall be equal to one-third the distance from the tree trunk to the tree's drip-line or as directed by the Engineer.

Once the tree wall location has been approved by the Engineer, the Contractor shall prune the tree's root. The location of the root pruning operation shall be equal to the width of the tree wall footing plus 1 foot. Root pruning limits shall be between the wall and tree trunk and shall extend the entire length of the wall. The depth of the root pruning shall be 18 to 24 inches. All root pruning operations shall be performed in accordance with **SECTION L.10** of these Specifications.

L.13.03.2 Tree Wells. The location of the face of the tree well shall be measured from the trunk of the tree and shall be a minimum of 4 feet.

Excavation for the tree well footing shall be no deeper than 6 inches. The width of excavation shall be equal to the width of the footing plus 6 inches measured from the face of the tree well.

L.13.03.3 Wall Construction. Tree walls and tree wells shall be constructed in accordance with **SECTION 911; STONE MASONRY WALLS**, with the following additions:

The Contractor shall lay stones in a manner which matches the character of the adjacent or adjoining walls. Mortar joints shall be deep raked to 3 inches, measured from the face of the wall.

Weep holes for tree wells shall be located 3 feet on center and 6 inches above the existing grade. Weep holes for tree walls shall be 3 feet on center and 6 inches above the proposed grade at the face of the wall.

L.13.04 METHOD OF MEASUREMENT. "Tree Wells" and "Tree Walls" shall be measured by the number of cubic yards of each item actually installed in accordance with the Plans, and/or as directed by the Engineer.

L.13.05 BASIS OF PAYMENT. The accepted quantities of "Tree Wells" and "Tree Walls" will be paid for at their respective contract unit prices per cubic yard as listed in the Proposal. The prices so-stated constitute 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.

Root pruning shall be measured and paid for in accordance with the requirements of **SECTION L.10; TREE AND SHRUB ROOT PRUNING**.

SECTION L.14

HERBICIDE

L.14.01 DESCRIPTION.

L.14.01.1 Pre-Emergent Herbicide Application in Mulch Areas. This work consists of the application of a pre-emergent herbicide on areas to be mulched as part of new planting operations or previously mulched areas to prevent new weed growth within the limits of the Contract, all in accordance with these Specifications.

L.14.01.2 Nonselective and Pre-Emergent Herbicide Application. This work consists of the application of either a nonselective herbicide or a pre-emergent herbicide or both herbicides to any areas where weeds are to be killed within the limits of the project, all in accordance with these Specifications.

L.14.02 MATERIALS. Non-selective and pre-emergent herbicides applied shall conform to the applicable requirements of **Subsection M.18.14; Herbicides**.

L.14.03 CONSTRUCTION METHODS.

L.14.03.1 Pre-Emergent Herbicide Application in Mulch Areas. After the completion of mulching operations, the Contractor shall apply a pre-emergent herbicide on all mulch areas as shown on the Plans or as directed by the Engineer.

The rate of application shall be in accordance with manufacturer's guidelines and approved by the Engineer. All work under this item must be performed by or under the direct supervision of a Rhode Island Licensed Commercial Applicator.

L.14.03.2 Nonselective and Pre-Emergent Herbicide Application. The Contractor shall apply these two herbicides to any area where weeds are to be killed within the limits of the project.

The chemicals can be applied in either separate applications or in one combined application. The rate of application for each chemical will be in accordance with manufacturer's directions and approved by the Engineer.

All work under this item must be performed by or under the direct supervision of a Rhode Island Licensed Commercial Applicator.

L.14.04 METHOD OF MEASUREMENT.

L.14.04.1 Pre-Emergent Herbicide Application in Mulch Areas. "Pre-Emergent Herbicide Application in Mulch Areas" for previously mulched areas will be measured by the number of square yards actually applied in accordance with the Plans and/or as directed by the Engineer.

a. New Planting Operations. Pre-emergent herbicide applications in mulch areas for new planting operations will not be measured separately but shall be included in the measurement for the individual plant material.

L.14.04.2 Nonselective and Pre-Emergent Herbicide Application. "Nonselective and Pre-Emergent Herbicide Application" will be measured by the number of square yards actually applied in accordance with the Plans and/or as directed by the Engineer.

L.14.05 BASIS OF PAYMENT.

L.14.05.1 Pre-Emergent Herbicide Application in Mulch Areas. The accepted quantity of "Pre-Emergent Herbicide Application in Mulch Areas" for previously mulched areas will be paid for at the contract unit price per square yard 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.

L.14.05.2 Nonselective and Pre-Emergent Herbicide Application. The accepted quantity of "Non-Selective and Pre-Emergent Herbicide Application" will be paid for at the contract unit price per square yard 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.

DIVISION III

PART M

MATERIALS

SECTION M.01

BORROW AND AGGREGATES

M.01.01 COMMON BORROW. Common borrow shall be gravelly in nature and shall conform to the minimum test data as specified below.

1. Boulders (retained on a 3-inch sieve) up to 9 inches in diameter and not exceeding three-quarters of the thickness of horizontal layers placed after compaction, as specified in **Subsection 202.03.2, Para. c**, are included for use in construction. However, these sizes are not included in the analysis for gradation.

2. The material shall contain not more than 17 percent by weight passing the No. 200 sieve.

M.01.02 GRAVEL BORROW. Gravel borrow shall consist of bank run sand and gravel or plant-processed, crushed or uncrushed gravel with fine aggregate added as filler. Alternatively, Gravel Borrow may consist of selected materials which have been reclaimed from within project limits, are proportioned and processed to produce granular material for reuse as Gravel Borrow within the source project limits. Gravel Borrow, whether consisting of bank run or plant processed sand and gravel, or reclaimed and processed granular material, shall consist of sound, durable particles free from loam, clay, organic soil, vegetative matter, soft and elongate particles.

M.01.02.1 Bank Run or Plant-Processed Sand and Gravel. Bank run or plant-processed sand and gravel proposed for Gravel Borrow shall be well-graded and meet the gradation requirements specified in Column Ia, Table I in **Subsection M.01.09.** In addition, the maximum particle size shall not exceed 9 inches or three-fourths of the loose lift thickness, whichever is smaller.

M.01.02.2 Reclaimed and Processed Granular Material. Gravel Borrow may be produced by reclamation of selected materials available within project limits, or other sources as approved by the Engineer, which are suitably proportioned and processed to produce a mixture of granular particles meeting the gradation requirements specified herein. Suitable materials may include: natural granular soils, boulders, or rock; roadway subbase, base and asphalt or concrete pavement; and other concrete, stone, brick, or cinder block, recovered from existing foundations, buildings, or selected utilities.

Materials not allowed for reclamation shall include but are not limited to: rubber, plastic, glass, wood, reinforcing steel or other metallic materials; building materials which may be sources of lead or asbestos; components of septic, leaching bed, and sanitary sewer systems

including soils, pipes, and structural concrete; soils or other materials contaminated by synthetic organic or inorganic compounds, metals, or petroleum hydrocarbon products.

Processing shall crush or pulverize and break down asphalt concrete conglomerations such that only bituminous coatings remain on aggregates. All materials suitable for reuse shall be broken down such that the processed mixture shall meet the gradation requirements specified in Column Ib, Table I in **Subsection M.01.09.**

M.01.03 PERVIOUS FILL. Pervious fill shall be clean, naturally occurring granular, bank run or plant processed soil materials. Pervious fill shall meet the gradation requirements of Column IV, Table I in **Subsection M.01.09**. The minimum permeability coefficient (k) of pervious fill shall be 1×10^{-4} c.p.s. as determined by a constant head permeometer (AASHTO T215).

M.01.04 BEDDING MATERIAL. Except as otherwise provided for in the Special Provisions and/or on the Plans, bedding material shall consist of gravel borrow, or crushed stone, or crushed or screened gravel.

Gravel borrow bedding material shall conform to the gradation requirements of Column I, Table I in **Subsection M.01.09**, except that 100 percent by weight shall pass the 1½-inch sieve.

Crushed stone and crushed or screened gravel bedding shall consist of the following gradation: 100 percent shall pass the 1½-inch sieve and zero-to-5 percent shall pass the #4 sieve.

M.01.05 COARSE AGGREGATE FOR BITUMINOUS CONCRETE AND PORTLAND CEMENT CONCRETE.

M.01.05.1 General Requirements. Aggregates accepted for State project use shall meet the applicable requirements of the Department and AASHTO (M43, M283, M80) Specifications except where amended or noted herein.

Crushed quarry rock and processed (crushed and/or screened) gravel aggregates shall be durable and shall not be weathered such that they degrade with handling and working, and shall be kept free of deleterious or organic matter.

Coarse aggregates shall meet the particular Los Angeles Abrasion and Crushing criteria specified in Table II **Subsection M.01.10** for use in asphalt or Portland cement concrete, and shall meet the criteria for soundness in **Subsection M.01.11** as measured by Sodium Sulfate loss. Aggregates shall be resistant to degradation by freeze and thaw and resistant to acid attack.

If lithology or physical character indicate that aggregates may be susceptible to degradation by freeze-thaw or acid attack, or potentially adversely reactive with Portland cement, the Department may require additional appropriate laboratory testing be performed to demonstrate that the aggregate is suitable for the intended use.

At least once a year the Department shall test and evaluate each single-source aggregate to be provided by all producers supplying State contracts.

M.01.05.2 Single-Source Requirements and Blending Policy. Each aggregate supply submitted for use in bituminous or Portland cement concrete mixes shall have been produced from either quarry rock or natural gravel, obtained from one distinct quarry source or natural gravel source whose location and boundaries are defined.

Blends of gravel aggregates from more than one source, blends of crushed quarry rock from more than one source, or blends of gravel with crushed rock which are produced by mixing these materials at the crusher feed, shall not be acceptable for use on State projects.

Controlled blending of approved aggregates at the asphalt or concrete production plants, of different aggregate types and/or aggregates from different sources, will be allowed, provided that each aggregate type from each separate source is stockpiled in a separate bin at the production plant; and, the Los Angeles abrasion and soundness values of each aggregate type from each source meets the criteria established for that type and for the intended asphalt pavement application or concrete use. The Department would require submittal of a separate mix design for each proposed coarse aggregate blend for review prior to approval.

M.01.05.3 Definitions of Quarry Rock and Gravel Sources.

a. Quarry Rock Source. A quarry rock source shall mean a distinct, stated location at which extensive, intact, consolidated bedrock of igneous, metamorphic, or sedimentary type, is or may be exposed by clearing and removal of overlying soil and boulder cover material, and from which exposed bedrock is then extracted by blasting or other mechanical means from a "working face," bench, or floor level, and reduced in size for final crushing and processing for the production of crushed quarry rock aggregates.

b. Gravel Source. A gravel source shall mean a distinct, stated location at which clay to boulder-sized materials, which may occur as mixed-size or stratified natural deposits, are or may be exposed by clearing, stripping, and removal of vegetation, topsoil, and organic soils, and are then excavated using conventional mechanical excavating equipment, for the production of crushed and/or screened gravel aggregates.

M.01.05.4 Definitions of Aggregate Types. Coarse aggregate shall be classified as "Crushed Quarry Rock" or "Processed Gravel" as defined below.

a. Crushed Quarry Rock. Crushed quarry rock shall be coarse aggregate consisting of 100 percent crushed bedrock, produced by crushing bedrock extracted from a single-source quarry location. Crushed quarry rock aggregate shall be processed separately from overburden soil deposits, shall not contain crushed or uncrushed gravel, and shall be free of deleterious material or soft, friable particles.

b. Processed Gravel. Processed gravel shall be coarse aggregate produced by crushing and/or screening naturally occurring boulder, cobble, and gravel-sized materials extracted from a single source location. Processed gravel shall be free of deleterious material or soft, friable particles.

M.01.06 KEYSTONE. Keystone or chipstone used for keying bases and pavements and cover stone for seal coats shall consist of crushed quarry rock or crushed gravel and shall conform to the gradation requirements of either Column III or VI, Table I, **Subsection M.01.09; Gradation of Aggregates**. Abrasion and soundness shall conform to the applicable require-ments of **Subsections M.01.10** and **M.01.11**, respectively. Keystone shall consist of at least 90 percent crushed particles; cover stone shall consist of 100 percent crushed particles.

M.01.07 FILTER STONE. Filter stone for underdrains shall conform to the gradation require-ments of Column V, Table I, **Subsection M.01.09.** Soundness shall conform to the applicable requirements of **Subsection M.01.11.**

M.01.08 FINE AGGREGATE. Fine aggregate used for asphalt or Portland cement concrete shall meet the general requirements of **Subsections M.02.02** and **M.03.02.2, Para. b** of these Specifications, and shall conform to the requirements for single-source origin, production and blending as described above in **Subsection M.01.05.2**.

Fine aggregate used for filler or seal coat cover shall consist of clean, hard, durable particles that meet the requirements of AASHTO M6.

M.01.09 GRADATION OF AGGREGATES. Aggregates for use in base and subbase courses and other applications shall conform to the gradation requirements indicated in the following Table I.

Table I

Gradation - Percent Passing

	I		II	III	IV	V	VI
	Gravel Borrow		Crushed				
	Ia	Ib	Stone				
	Bank Run	Reclaimed	or				
Sieve	Proc Sand/	Processed	Crushed		Pervious	Filter	Cover
Size	Gravel	Material	Gravel	Keystone	Fill	Stone	Stone
3"	60-100	100			100		
2¼"			100				
2"			90-100				
1½"		70-100	30-55				
1¼"			0-25				
1"			0-5	100		100	
3/4"		50-85		90-100		70-85	100
½"	50-85			20-55		10-40	90-100
3/8"	45-80			0-20		0-20	30-60
#4	40-75	30-55		0-5	30-100	0-5	0-15
#8							0-5
#40	0-45						
#50		8-25					
#200	0-10	2-10			0-8		

M.01.10 ABRASION AND CRUSHING REQUIREMENTS FOR COARSE AGGREGATES. Coarse aggregate to be used for asphalt or Portland cement concrete may be either crushed quarry rock or processed gravel meeting the abrasion and crushed particle/fracture face criteria in Table II on the following page. Abrasion resistance shall be determined by Los Angeles Abrasion Test AASHTO T96.

Table II - Los Angeles Abrasion Criteria

Portland Cement Concrete Applications:

Crushed Quarry Rock ..... 45% max. loss

Processed Gravel ..... 45% max. loss
(Crushing not required)

Bituminous Applications:

Aggregate Type	Bituminous Base/Binder Courses	Bituminous Surface & Friction Courses	Seal Coats: Keystone & Cover Stone
Quarry Rock	50% max.loss	40% max.loss	30% max.loss
Processed Gravel (Notes 1, 2, 3)	50% max.loss	40% max.loss	30% max.loss

Notes: Crushing Requirements for Processed Gravel for Asphalt

1) Base and binder courses: 75 percent by weight particles with one or more fracture faces.

2) Surface and friction courses: 95 percent by weight particles with at least one fracture face, and 75 percent by weight, particles with at least two fracture faces.

3) Keystone: 90 percent crushed particles; Cover stone: 100 percent crushed particles.

M.01.11 SOUNDNESS, SODIUM SULFATE. Aggregate materials shall have a maximum percentage loss of 12 percent as determined by the Sodium Sulfate Test, AASHTO T104.

SECTION M.02

PORTLAND CEMENT CONCRETE

M.02.01 HYDRAULIC CEMENT

M.02.01.1 Portland Cement. Portland cement shall conform both to the chemical and physical requirements of AASHTO M85 and be listed on the Department's Approved Materials List.

In addition, the cement shall conform to the following requirements:

1. The cement shall not contain more than 0.60 percent by weight of alkalies, calculated as the percentage of Na_2O plus 0.658 times the percentage of K_2O, when determined by either direct intensity flame photometry or by the atomic absorption method. The instrument and procedure used shall be qualified as to precision and accuracy in accordance with the requirements of ASTM C114.

The Engineer may raise the maximum alkali content of the cement to 0.75 percent for concrete that uses non-expansive aggregate or aggregate considered innocuous based upon acceptable values for test methods ASTM C1260 or AASHTO T303. Test results must be submitted and approved by the Engineer before this is permitted.

To propose an increase to maximum alkalies, the Contractor must submit an independent testing laboratory results of ASTM C1260; “Potential Alkali Reactivity of Aggregates (Mortar Bar Method)” or AASHTO T303; “Accelerated Detection of Potentially Deleterious Expansion of Mortar Bars Due to Alkali-Silica Reaction.” For either test, mean expansion of the test specimens of less than 0.10 percent at 16 days from casting will suffice to indicate that the aggregate is non-reactive and will validate the use of a cement which has an alkali content not to exceed 0.75 percent by weight of alkalies.

If the ASTM C1260 or AASHTO T303 test results do not indicate that the aggregate is non-reactive or are inconclusive, the Contractor may submit to the Engineer results of ASTM C289; “Potential Alkali-Silica Reactivity of Aggregates (Chemical Method),” ASTM C227; “Potential Alkali Reactivity of Cement-Aggregate Combinations (Mortar Bar Method),” and ASTM C295; “Petrographic Examination of Aggregates for Concrete.”

Petrographic analysis in accordance with ASTM C595 shall identify the constituents of the fine and coarse aggregate. Fine and coarse aggregate containing more than the following quantities of constituents shall be considered potentially reactive:

Optically strained, microfractured, or microcrystalline quartz exceeding 5.0 percent (a common constituent of granite and granite gneiss).

Chert or chalcedony exceeding 3.0 percent.

Tridymite or cristobalite exceeding 1.0 percent.

Opal exceeding 0.5 percent.

Natural volcanic glass in volcanic rocks exceeding 3.0 percent.

Mortar bar expansion measurements (ASTM C227) are to be made at three months and at six months and the results shall be submitted to the Engineer at those times. The guidelines in the appendix to ASTM C33; “Standard Specification for Concrete Aggregates“ will be followed to determine whether an aggregate is non-expansive or innocuous. The guidelines state that expansion will be considered excessive at three months if it exceeds 0.05 percent, but that an expansion greater than 0.05 percent at three months will not be considered excessive if the six-month expansion remains below 0.10 percent.

The petrographic examination (C295), chemical method (C289), and the six-month mortar bar expansion (C227) will be definitive. However, interim acceptability based on the petrographic analysis, the chemical method and the three-month mortar bar expansion will be considered until the six-month test is complete. Such interim acceptance will be granted only when the previous year’s six-month mortar bar expansion results were satisfactory.

Documentation from an independent laboratory certifying that the aggregate is non-expansive and innocuous must be submitted to the Engineer annually. An acceptable independent testing laboratory shall conduct each test.

Analysis to document alkali content and conformance to AASHTO M85 must be included on all mill test reports submitted to this office.

2. The autoclave expansion shall not exceed 0.50 percent when tested in accordance with AASHTO T107.

M.02.01.2 Blended Hydraulic Cements. Blended hydraulic cements shall both conform to the chemical and physical requirements of AASHTO M240 and be listed on the Department's Approved Materials List.

M.02.01.3 Masonry Cement. Masonry cement shall both conform to ASTM C91 and be listed on the Department's Approved Materials List.

M.02.02 FINE AGGREGATE FOR CONCRETE. Fine aggregate for concrete shall conform to the requirements of AASHTO M6 and shall consist of natural sand, manufactured sand produced from larger aggregate, or a combination thereof. Manufactured sand shall be graded with a minimum percentage of flat elongated particles. All fine sand shall consist of hard, strong, durable particles which are free from coatings or any injurious materials and injurious amount of clay, loam, or other deleterious substances. In addition the fine aggregate shall not contain substances which, when mixed in Portland cement concrete, produce an unacceptable level of chloride ions in the final product. Substances that produce chloride ions shall be considered deleterious material. Any fine aggregate may be rejected if it is determined by the Engineer to contain sufficient amounts of unsound or deleterious material to be harmful.

M.02.02.1 Fine Aggregate for Mortar. Fine aggregate for mortar shall conform to the requirements of AASHTO M45.

M.02.03 COARSE AGGREGATE FOR CONCRETE. Coarse aggregate shall consist of screened gravel, crushed gravel, or crushed quarry rock. Coarse aggregate for concrete shall conform to the

requirements of AASHTO M80, with the exception that grading shall conform to the requirements in the following tabulation:

Gradation of Coarse Aggregate
In Terms of Amounts Finer than Each Laboratory Sieve
Percent by Weight

	Sieve Sizes								
Aggregate Size	2"	1½"	1"	3/4"	½"	3/8"	No.4	No.8	No. 16
1½"	100	85-100	---	35-70	---	10-30	0-5	---	---
1"	---	100	85-100	---	20-55	---	0-5	---	---
3/4"	---	---	100	85-100	---	20-55	0-10	0-5	---
½"	---	---	---	100	85-100	40-75	5-25	0-10	---
3/8"	---	---	---	---	100	85-100	20-55	5-30	0-10

Coarse aggregate for Portland cement concrete shall have a percent loss of not more than the following amounts as determined by AASHTO T96 (Los Angeles Abrasion Test).

Type of Coarse Aggregate	**Percent Loss (max.)**
Crushed Quarry Rock	45
Screened or Crushed Gravel	45

M.02.04 CURING MATERIALS. Curing materials shall conform to the following requirements.

M.02.04.1 Burlap Cloth. Burlap cloth made from jute or Kenaf shall conform to the requirements of AASHTO M182 Class 3 or 4. Burlap shall be clean and free from cuts, tears, uneven weaving and contaminants.

M.02.04.2 Sheet Materials for Curing Concrete. The use of waterproof paper is not allowed as a curing medium for Portland cement concrete.

Polyethylene Film. Polyethylene film clear or white opaque shall conform to the test requirements of ASTM C171.

Plastic Coated Fiber Blankets. White plastic coated fiber blankets or white plastic coated absorbent synthetic fabric blankets shall conform to the test requirements of AASHTO M171, Table 1, for white-burlap polyethylene sheets, for moisture loss and reflectance.

M.02.04.3 Liquid Membrane Curing Compounds. Liquid membrane curing compounds shall be non-pigmented-chlorinated rubber base-clear and shall conform to AASHTO M148. Curing compounds must be selected from the Department's Approved Materials List. The loss of water, when tested as specified, shall be not more than 0.15 kilograms per square meter in 24 hours nor more than 0.45 kilograms per square meter in 72 hours.

M.02.05 CHEMICAL ADMIXTURES. Calcium Chloride in any form shall not be used in any Portland cement concrete.

No chemical admixtures shall be used in the work unless they are approved by the Engineer.

Chemical admixtures shall be those listed on the Department's Approved Materials List and shall conform to the requirements below:

Chemical Admixtures - AASHTO M194

Air-entraining Admixtures - AASHTO M154

M.02.06 MINERAL ADDITIVES. Mineral additives shall be on the Department's Approved Materials List and shall conform to the requirements indicated below.

M.02.06.1 Fly Ash. Fly Ash for replacement of Portland cement shall conform to the chemical and physical requirements of AASHTO M295, Class C or F, except for the loss on ignition which is a maximum of 4 percent.

M.02.06.2 Silica Fume. Silica Fume shall conform to the chemical and physical requirements of AASHTO M307.

M.02.06.3 Ground Granulated Blast Furnace Slag. Ground granulated blast furnace slag shall conform to the chemical and physical requirements of ASTM C989; Grades 100 or 120.

M.02.07 WATER. Water used in mixing and curing of concrete shall be subject to approval and shall be reasonably clean and free of oil, salt, acid, alkali, sugar, vegetable, or other substance injurious to the finished project. Water shall be tested in accordance with AASHTO T26. Water known to be of potable quality may be used without test. Where the source of water is relatively shallow, the intake shall be so enclosed as to exclude silt, mud, grass or other foreign materials.

When comparative compressive tests are made in conformance with AASHTO T106, any indication of unsoundness, marked change in time of setting, or a reduction of more than 10 percent in mortar strength, shall be sufficient cause for rejection of the water under test.

In all concrete work, except for prestressed and post-tensioned concrete, the water shall not contain more than 1,000 parts per million of chlorides as Cl, nor more than 1,300 parts per million of sulfates as SO_4.

In prestressed concrete work, the water shall not contain more than 650 parts per million of chlorides as Cl, nor more than 1,300 parts per million of sulfates as SO_4.

In no case shall the water contain an amount of impurities that will cause a change in the setting of Portland cement.

In addition to the above requirements, water for curing concrete shall not contain any impurities in sufficient amounts to cause discoloration of the concrete or produce etching of the surface.

In addition to the foregoing requirements of this Section, such water shall not contain coloring agents or more than 300 parts per million of alkalies ($Na_20+0.65K_20$) as determined on the filtrate. The specific gravity of such water mixture shall not exceed 1.034 and shall not vary more than ±0.010 during any day's operations.

M.02.08 LATEX EMULSION ADMIXTURE. Formulated latex admixture shall be a non-hazardous, film forming, polymeric emulsion in water to which all stabilizers have been added at the point of manufacture and shall be homogeneous and uniform in composition. The admixture shall have less than 1,000 ppm of total chloride ions. Only one brand shall be supplied.

a. Latex. The physical properties of the latex modifier shall conform to the following requirements:

Polymer Type:	Styrene Butadiene
Stabilizer:	
a) Latex:	Nonionic Surfactants
b) Portland Cement Composition:	Poly Dimethyl Siloxane
Percent Solids:	47.0 - 49.0
Weight per Gallon: (lbs. at 25°C)	8.4
Color:	White

M.02.09 CONCRETE PAVEMENT JOINTS.

M.02.09.1 Transverse and Longitudinal Joints. These joints shall consist of load transfer devices, poured joint seal, and expansion joint filler. Expansion joint filler shall be preformed joint filler.

Tie bars shall be deformed conforming to the requirements of AASHTO M31 or M42, except that rail steel shall not be used for bars that are to be bent and re-straightened during construction. Dowel bars shall be plain round bars conforming to AASHTO M254 and M255, and shall be free from burring or other deformation restricting slippage in the concrete. One-half the length of each bar shall be treated with a bond-breaker material.

The sleeves for dowel bars shall be metal of an approved design to cover 2 inches, plus or minus 1/4-inch, of the dowel with a closed end, and with a suitable stop to hold the end of the sleeve at least 1 inch from the end of the dowel bar.

M.02.10 JOINT MATERIALS FOR CONCRETE PAVEMENTS.

M.02.10.1 Preformed Joint Filler. Preformed joint filler shall conform to AASHTO M153 Type II; Expanded Rubber Specification ASTM D1056, Type 2C2; or AASHTO M33 and M213.

M.02.10.2 Poured Joint Sealer. Poured joint sealer shall be a rubber compound of the hot poured type, conforming to the requirements of AASHTO M173 unless otherwise noted on the Plans or Special Provisions.

M.02.10.3 Preformed Neoprene Compression Seals and Lubricant Adhesive.

a. Neoprene Seals. Seals shall be preformed and manufactured using polychloroprene as the only base polymer. The seal shall be free of curling, pin holes and uncured areas and shall be uniform in all dimensions. The accepted width and height of the seal shall not be less than the dimensions designated by the seal manufacturer and shall be known as the nominal width and nominal height. The actual width of the seal shall not exceed the nominal width by more than 0.0625 inch for seals up to 1.50 inches, 0.1875 inch for seals 1.50 to 2.50 inches. In addition, the actual height of a seal shall not exceed the nominal by more than 0.125 inch for seals 2.5 inches and less and 0.250 inch for larger seals.

The preformed compression seal shall be of adequate design and strength to prevent the intrusion of debris into a sealed joint through repeated cycles of expansion and contraction. It shall function properly at all temperatures between -20°F and 140°F and shall collapse downward symmetrically along the vertical center plane of the seal design. When the seal is in a compressed condition, misalignment of the walls shall not exceed 0.125 inch for seals of nominal width 2 inches and less and 0.250 inch for seals of nominal width greater than 2 inches.

Seals shall meet all physical requirements of AASHTO M220 (ASTM D2628; Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements), except that seals of nominal width greater than 4 inches shall have a tensile strength of not less than 2,000 psi.

The compression deflection characteristics of the fabricated seal shall be determined using ASTM D575 Method A. Test specimens shall be 4 inches in length for seals 1.25 inches and less in nominal width and 6 inches for seals of nominal width greater than 1.25 inches. Seals shall be conditioned through six complete cycles of compression and all readings taken on the seventh cycle. At 20 percent compression of the nominal width, seals 1.25 inches and less shall exert a stress of not less than 1.5 pounds per linear inch per inch height of seal and have a safe compressibility of 40 percent or less of the nominal width.

Seals of nominal width greater than 1.25 inches shall exert a stress of not less than 2 pounds per linear inch per inch height of seal at 20 percent compression and have a safe compressibility of 50 percent or less of the nominal width. The maximum safe compressibility is that point in compression where the air voids are closed and the elastometer itself is in compression. The maximum safe compressibility shall not exceed 100 pounds per linear inch per inch height of seal at the above stated safe compressibility levels.

The compression-deflection characteristic of the seal will be used to classify the seal according to movements of 0.05, 1.0, 1.5 and 2.0 inches. No tolerance on movement classification will be permitted. The movement of the seal as determined above, shall exceed or be equal to its classification.

Each seal will be qualified for only one movement and will not be used for other movements.

b. Lubricant Adhesive. A lubricant adhesive to aid in seal installation shall be approved by the Engineer. The lubricant adhesive shall be single component neoprene polymer with only necessary antioxidants and acid acceptors and shall be in a hydrocarbon solvent. It shall remain fluid at temperatures between 5°F and 120°F and shall contain not less than 22 percent total solids by weight as determined by ASTM D2369. The peel strength of the lubricant adhesive as determined by ASTM D903, shall be not more than 1,500 psi. The lubricant adhesive shall be compatible with the preformed compression seals, concrete, asphalt, sealing compounds and shall not be affected by moisture. The lubricant shall have a minimum shelf life of nine months.

M.02.10.4 Silicone Highway Joint Sealant. The silicone joint sealant shall be a one-part silicone material that readily extrudes over a wide temperature range and cures to produce a durable, flexible, low modulus silicone rubber joint seal. It shall have an extension recovery of 100 percent and a compression recovery of 50 percent of the original joint width.

The silicone sealant shall meet the requirements of Federal Specifications TT-S-01543 A Class A (one-part silicone sealants) and TT-S-00230 C Class A (one component sealants).

Limitations. Silicone sealant is not intended for continuous water immersion, and it should not be applied in totally confined spaces where the sealant is not exposed to atmospheric moisture. The sealant should never be applied to wet or damp surfaces nor should it be installed during inclement weather. It shall be applied not thicker than ½-inch and no thinner than 1/4-inch an approximate width to depth ratio of 2-to-1.

M.02.11 JOINT MATERIALS FOR BRIDGE STRUCTURES. The expansion, contraction and construction joints in concrete and masonry construction shall be made with or without joint filler and sealed as shown on the Plans.

M.02.11.1 Preformed Expansion Joint Filler.

a. Bituminous Type. This type of joint filler shall consist of preformed strips of a composition which shall conform to AASHTO M33.

b. Non-Extruding and Resilient Type. Cork joint material shall conform to AASHTO M153, Type II or III.

Expanded rubber joint filler shall be preformed strips in the thickness as shown on the Plans, of durable elastic expanded rubber, gray in color, containing no reclaimed rubber or factice. The expanded rubber joint filler shall conform with ASTM D1056 Type 2C2.

c. Preformed Polyethylene Foam Joint Filler. The preformed joint filler shall be a closed cell polyethylene foam material recommended for use in sealing expansion joints in concrete. It shall be chemically resistant and capable of being used in conjunction with cold applied polymer sealants such as silicones, polyurethanes and polysulfides. The material shall be waterproof and shall remain flexible in cold weather.

M.02.11.2 Joint Seal (Poured and Caulked Types). The grooves for joint seals shall be formed when the concrete is placed, shall be wire brushed clean, all dust blown free with compressed air, shall be surface dry, primed and filled with a poured or caulked joint seal as specified on the Plans. Joint sealer shall be an approved poured or caulk type placed in accordance with the manufacturer's recommendations.

a. Silicone Bridge Joint Sealant. The requirements for silicone joint sealant for bridges is identical as that set forth for highways in **Subsection M.02.10.4** of these Specifications.

M.02.11.3 Mastic Joint Sealer. Mastic sealer shall conform to the following Specifications:

a. Primer. The primer shall be a solution of gilsonite and petroleum asphalts and non-oxidizing resinous plasticizers. It shall neither contain tar nor be an emulsion. It shall form a vapor resistant film when dry.

b. Sealer. The mastic extruded rope joint sealer shall be a material of uniform, stiff consistency and shall contain no solvents. The mastic shall, when installed, tenaciously adhere to primed concrete surfaces and shall remain permanently mastic and not contaminate potable water. The material shall be of a type that will, when properly installed, effectively and permanently seal joints subject to movement in concrete.

M.02.11.4 Poured Neoprene Sealant - Type "G." Poured neoprene sealant, shall be a two-compound, cold-applied, self-leveling, neoprene sealant.

M.02.11.5 Polyurethane Joint Sealant. The polyurethane joint sealant shall be a one-component, moisture-cured, high-performance, premium-grade, non-sag elastomeric sealant. It shall be designed for an extension and compression recovery of 25 percent maximum. The polyurethane joint sealant shall meet the requirements of Federal Specifications TT-S-00230C, Type II Class A.

The color of the polyurethane joint sealant shall be limestone, aluminum gray, or precast at the discretion of the Engineer.

M.02.11.6 Polyurethane Elastomeric Joint Sealant. The polyurethane elastomeric joint sealant shall be a two-component, chemically-cured, high-performance, premium-grade, non-sag elastomeric sealant. It shall be designed for an extension and compression recovery of 50 percent maximum. The polyurethane elastomeric joint sealant shall meet the requirements of Federal Specifications TT-S-00227E.

The color of the polyurethane elastomeric joint sealant shall be limestone, aluminum gray, or precast at the discretion of the Engineer.

SECTION M.03

BITUMINOUS PAVEMENTS

M.03.01 BITUMINOUS CONCRETE PAVEMENT. Coarse and fine aggregates, mineral filler, and asphalt cement shall be combined to produce bituminous concrete pavements in accordance with the gradation requirements, physical properties and test limits indicated in the following Table.

SIEVE SIZE	BASE COURSE	BINDER COURSE	BRIDGE BINDER	SURFACE COURSES: CLASS I-1	SURFACE COURSES: CLASS I-2 or SIDEWALK	FRICTION COURSES: DENSE	FRICTION COURSES: RAMP
GRADATION: PERCENT PASSING BY WEIGHT							
1¼"	100						
1"		100				100	
3/4"	70-100	70-100		100		90-100	100
½"			100	80-95	100	70-90	95-100
3/8"	46-74	46-74	70-100	70-90	95-100	45-75	70-100
#4			25-45	50-70	55-75	20-40	25-45
#8	22-52	22-52	20-35	35-50	40-55	8-18	20-35
#30	10-34	10-34		18-29	20-30		8-15
#50	6-26	6-26	8-17	13-23	10-20	4-12	5-12
#200	3-8	3-8	2-6	3-8	3-8	2-6	2-6
Asphalt % By Weight	4.0 - 6.5	4.0 - 6.5	5.0 - 7.0	5.5 - 7.0	6.0 - 7.5	4.5 - 5.5	5.0 - 7.0
Marshall Stability lbs.(min.)	1600	1600	750	1000	1000	750	750
% Voids	3 - 8	3 - 8	3 - 8	3 - 5	3 - 5	8 min.	5 min.
VFA	60 - 75	60 - 75	-	65 - 85	65 - 85	-	-
Flow (0.01in)	8 - 16	8 - 16	8 - 16	8 - 16	8 - 16	-	8 - 16
Mixing Temp.°F	300	300	260	300	300	260	260
Compac-tion #blows at ea. end.	75	75	50	50	50	50	50

M.03.02 MATERIALS.

M.03.02.1 Performance-Graded Asphalt Cement.

a. Scope. This Specification covers performance graded asphalt cement for use in pavement construction.

b. Manufacture. The asphalt cement shall be prepared from crude petroleum by suitable methods. The supplier shall conform to the requirements of AASHTO R26; "Standard Practice for Certifying Suppliers of Performance Graded Asphalt Binders," and shall submit annually a quality control plan conforming to R26.

Approved temperature-viscosity charts and test data shall be provided by the supplier in accordance with these Specifications.

c. Requirements. The asphalt cement shall be homogeneous, free from water, and shall not foam when heated to 175°C (347°F).

The asphalt cement shall be sampled and tested in accordance with and meet all the requirements of AASHTO MP1a for PG 64-28 binder.

M.03.02.2 Aggregate for Bituminous Pavements.

a. Coarse Aggregate. Coarse aggregate (retained on the No. 8 sieve) shall be crushed stone, or crushed gravel, and, unless otherwise stipulated, shall conform to the respective requirements of **Subsections M.01.05, M.01.10** and **M.01.11** of these Specifications.

b. Fine Aggregate. Fine aggregate shall consist of sand, stone screenings or a mixture of sand and stone screenings. Stone screenings and sands shall be free from dirt, clay, organic matter, excess fines or other deleterious materials. Fine aggregates shall conform to the quality requirements of AASHTO M29.

Fine aggregate shall be of such gradation that when proportionally combined with other required aggregate fractions, the resultant mixture will meet the gradation required under the composition of mixture for the specified class.

M.03.02.3 Filler. Filler material for use in asphalt mixtures shall conform to the requirements of AASHTO M17.

M.03.03 BITUMINOUS MATERIAL.

M.03.03.1 Asphalt Cement shall conform to the requirements of **Subsection M.03.02.1; Performance Graded Asphalt Cement.**

M.03.03.2 Medium Curing Cut-back Asphalt shall conform the requirements of AASHTO M82.

M.03.03.3 Rapid Curing Cut-back Asphalt shall conform to the requirements of AASHTO M81.

M.03.03.4 Emulsified Asphalt shall conform to the requirements of AASHTO M140.

M.03.04 HIGH PERFORMANCE COLD PATCHING MATERIAL.

M.03.04.1 General Requirements. This material shall be a plant mixed, high performance cold patching material composed of mineral aggregates, a modified bituminous material, and capable of storage in a stockpile for a minimum of one year. The material shall be capable of being placed in all conditions, including wet snow conditions, with no pothole preparation and a minimum of labor including the shoveling of the material into the pothole and compacting with a truck tire.

M.03.04.2 Aggregates. Aggregates shall be obtained from a source approved by the Department and shall satisfy all requirements of the manufacturer of the bituminous material who shall attest to the same.

a. Coarse Aggregate. Coarse aggregate shall be either crushed ledge, crushed granite, or crushed gravel and shall meet requirements of **SECTION M.01** of these Specifications for surface course aggregates.

b. Fine Aggregate. Fine aggregate, if used, shall be natural sand, stone screening, or a blend of the two.

c. Mineral Filler. Mineral filler, if used, shall conform to the requirements of **Subsection M.03.02.3; Filler**.

M.03.04.3 Bituminous Material. The bituminous material shall be on the Department's Approved Materials List for high performance cold patch.

M.03.04.4 Mixture.

a. Proportioning. The manufacturer of the bituminous material shall submit a master range and job-mix formula for the aggregate to be used. In no case shall the tolerance for the percent passing a sieve exceed the following:

No. 4 and larger	± 7
No. 100 to No. 8	± 4
No. 200	± 2

b. Mix Design. The mix, including the determination of the optimum bituminous material content, shall be designed in accordance with the recommendations of the manufacturer of the bituminous material.

c. Verification of Mixture and Mix Design. The Contractor shall be required to submit samples of the following at least three weeks before production for verification testing:

- 5 kg sample of the high performance cold patching mixture.
- 5 kg sample of the coarse aggregate.
- 2 kg sample of the fine aggregate, if used.
- 1 kg sample of the mineral filler, if used.
- 1 quart sample of the modified bituminous material.

NOTE: The 5 kg sample of high performance cold patching mixture may be from a lab batch or a plant mix.

The Contractor shall also submit, at least three weeks before production, copies of the bituminous material manufacturer's results of the following tests:

1. Mixture

Static immersion (AASHTO T182)

Boiling water immersion (a 200 gram sample of completely coated mixture is immersed for 3 minutes in a beaker of boiling distilled water. The sample is stirred at a rate of one revolution per second throughout the immersion period. At the conclusion of this period, the sample is drained and the percent of aggregate surface that remains coated is recorded. There shall be a minimum 24-hour curing period from the time of mixing until this test is performed).

2. Coarse Aggregate

Specific Gravity and Absorption (AASHTO T85)
Sieve Analysis (AASHTO T27)
Washed Sieve Analysis (AASHTO T11)
Los Angeles Abrasion (AASHTO T96)
Sulfate Soundness (AASHTO T104)
Percent fractured particles, based on:

a) One fracture face
b) Two or more fracture faces.

3. Fine Aggregate (if used)

Specific Gravity and Absorption (AASHTO T84)
Sieve Analysis (AASHTO T27)
Washed Sieve Analysis (AASHTO T11)

4. Mineral Filler (if used)

Sieve Analysis (AASHTO T37)

5. Bituminous Material

Viscosity -
Saybolt (AASHTO T72)
or Kinematic (AASHTO T201)

d. Mixture Performance Requirements.

1. The aggregate shall be completely coated with bituminous material.

2. The extracted gradation and bituminous material content shall conform to the requirements of the approved mix design.

3. The retained coating shall be at least 95 percent when the mixture is tested for stripping by:

a) Static immersion (AASHTO T182)
b) Boiling water immersion (above).

M.03.04.5 Production Methods. Production may commence only after the Engineer's acceptance and approval of the above required submittals. The Contractor shall be required to give the Department two days notice prior to commencement of production.

a. Process Control. Prior to and during production, the Contractor shall have at the mix-production plant a qualified technical representative of the manufacturer of the bituminous material who, in conjunction with the Contractor, shall be responsible for the process control during production. In addition, this representative, in conjunction with the Contractor, shall be responsible for all production quality control. This shall include, but not be limited to, the performance of all necessary tests, checks, and verifications on the aggregate, bituminous components and mixture to insure product compliance. Furthermore, it is imperative that only specified and approved materials shall be used and that the production process recommended by the manufacturer of the bituminous material shall be followed.

The process control of the bituminous material manufacturer shall include providing written instructions, in conformance with his product literature, for the proper production, handling, storage, placement, and utilization of the high performance cold patching material. In addition, a qualified technical representative of the bituminous material manufacturer shall be available for at least one day to instruct the applicator in the handling of the material and to observe placement of the same.

b. Acceptance Testing. Acceptance testing will be performed by the Engineer. Based on the acceptance tests and performance of the mixture, the Engineer shall accept or reject the mixture produced.

NOTE: Acceptance of the material by the Department will be undertaken only after satisfactory acceptance testing and performance of the mixture.

c. Manufacture. The mix shall be produced in an approved plant and in accordance with the relevant and applicable provisions of **SECTION 400** of these Specifications, and in strict accordance with manufacturer's recommendations.

d. Stockpiling. The Contractor shall stockpile the material in a manner and method that is not injurious to the mixture or its performance as a patching material. The stockpile shall be kept free from all contamination. Stockpiling shall be in accordance with the manufacturer's recommendations with the exception that the material shall be able to be stockpiled either indoors or outdoors under naturally prevailing weather conditions.

SECTION M.04

DRAINAGE

M.04.01 CONCRETE, CLAY, FIBER AND PLASTIC PIPE.

M.04.01.1 Non-reinforced Concrete Pipe. Pipe shall conform to the requirements of AASHTO M86 and **SECTION 601** of these Specifications for the specified diameters and strength classes.

M.04.01.2 Reinforced Concrete Pipe. Pipe shall conform to the requirements of AASHTO M170 and **SECTION 601** of these Specifications for the specified diameters and strength classes. Elliptical pipe shall also conform to the requirements of AASHTO M207. Unless otherwise specified, pipe wall design and use of elliptical reinforcement in circular pipe are optional.

Precast reinforced concrete end sections shall conform to the requirements of the cited Specifications to the extent to which they apply.

M.04.01.3 Perforated Concrete Pipe. Pipe shall conform to the requirements of AASHTO M175 and **SECTION 601** of these Specifications for the specified diameters and strength classes.

M.04.01.4 Concrete and Clay Drain Tile. Pipe shall conform to the requirements of **SECTION 601** of these Specifications and AASHTO M178 or M179 for the specified material, diameters and quality classes. When specified, the pipe spigot shall have integral spacer lugs to provide for an annular opening and self-centering feature.

M.04.01.5 Porous Concrete Pipe. Pipe shall conform to the requirements of AASHTO M176 and **SECTION 601** of these Specifications for the specified diameters.

M.04.01.6 Vitrified Clay Lined Reinforced Concrete Pipe. Designs for fully lined or half lined pipes of the specified strength classes shall be submitted by the manufacturer for approval. The applicable requirements of **SECTION 601,** AASHTO M170 and M65 shall govern. Liner, or liner elements, shall be vitrified clay of first quality, sound, thoroughly and perfectly burned without warps, cracks, or other imperfections, and fully and smoothly salt glazed..

M.04.01.7 Clay Pipe. Pipe shall conform to the requirements of AASHTO M65, for pipe with full circular cross section, for the specified diameter and strength class. When specified, the bell shall have integral spacer lugs to provide for an annular opening and self-centering feature.

M.04.01.8 Vitrified Clay Pipe. Pipe shall conform to the requirements of AASHTO M65 for the specified diameters and strength classes for circular, unperforated pipe. When so specified, the bell shall have integral spacer lugs to provide for an annular opening and self-centering feature.

M.04.01.9 Cradle Invert Clay Pipe. Pipe shall conform to the applicable requirements of AASHTO M65.

M.04.01.10 Plastic Sewer Pipe. Plastic sewer pipe to be used as pipe culvert shall conform to the applicable requirements of WW-P-00380 (GSA-FSS) and the following additional stipulations.

a. Purpose. The purpose of this Specification is to provide a standard for large diameter plastic sewer pipe jointed by means of solvent welding.

b. Pipe Sizes and Dimensions.

1. Pipe shall be furnished in the following diameter:

Size	Nominal O.D.	Maximum Wall	Nominal Wall
12"	12.50"	0.500"	0.250"

2. Standard length of plastic sewer pipe shall be 10 feet.

3. Pipe sections shall be furnished with a plastic sleeve coupling which may be solvent welded to the one end of the pipe section.

c. Physical and Chemical Properties.

1. Crushing Strength. Crushing strength of the finished pipe shall be a minimum of 1,200 pounds per linear foot as determined by ASTM C301 (Sand Bearing Method Section 8).

2. Straightness. The maximum ordinate as measured from the concave side of the pipe must not exceed 1/4-inch per foot of pipe length.

3. Quality and Appearance. Pipe shall be free from defects, bubbles and other imperfections in accordance with accepted commercial practice.

4. Joint Tightness. Solvent welded connections shall be capable of standing an internal pressure of 10 psi for a period of 24 hours without leakage.

M.04.01.11 Perforated Corrugated Polyethylene Drainage Pipe. This classification of pipe shall conform to the requirements of AASHTO M252 and M294.

M.04.01.12 Perforated and Unperforated Polyvinyl Chloride Pipe. This classification of pipe shall conform to the requirements of AASHTO M278.

M.04.02 METAL PIPE.

M.04.02.1 Ductile Iron Pipe. This pipe shall conform to the requirements of ASTM A716 for the specified diameters and strength classes. Unless otherwise specified, either smooth, corrugated or ribbed pipe may be furnished. Pipe of diameter in excess of 48 inches shall conform to the USASI Standard for Cast Iron Pit Cast Pipe for the specified diameter and strength class.

M.04.02.2 Corrugated Steel Pipe and Pipe Arches. These conduits and the coupling bands shall conform to the requirements of AASHTO M36 for the specified sectional dimensions and gauges. Shop-formed elliptical pipe and shop-strutted pipe shall be furnished where specified.

Special sections, such as elbows and flared end sections, for these conduits shall be of the same gauge as the conduit to which they are joined, and shall conform to the applicable requirements of AASHTO M36.

M.04.02.3 Bituminous Coated Corrugated Metal Pipe and Pipe Arches. These conduits and the coupling bands shall conform to the requirements of AASHTO M190 for the specified sectional dimensions, gauges, and type of bituminous coating. Coupling bands shall be fully coated with bituminous material. Shop-formed elliptical pipe and shop-strutted pipe shall be furnished where specified.

Special sections, such as elbows and flared end sections, for these conduits shall be of the same gauge as the conduit to which they are joined, and shall conform to the applicable requirements of AASHTO M190. Coating and invert paving shall be of the type specified.

M.04.02.4 Perforated Corrugated Steel Pipe for Underdrains. Pipe shall conform to the requirements of AASHTO M36 Type III for the specified diameters. Unless otherwise specified, any one of four types may be furnished.

M.04.02.5 Bituminous Coated Perforated Corrugated Metal Pipe for Underdrains. Pipe shall conform to the requirements of AASHTO M190 and shall be coated with a Type A coating installed on AASHTO M36 Type III pipe. Coupling bands shall be fully covered.

M.04.02.6 Corrugated Aluminum Pipe. Pipe shall conform to the requirements of AASHTO M196 and M197.

Special sections, such as elbows and flared end sections, for these conduits shall be of the same gauge as the conduit to which they are joined, and shall conform to the applicable requirements of AASHTO M196 and M197.

M.04.02.7 Perforated Corrugated Aluminum Alloy Pipe for Underdrains. Pipe shall conform to the requirements of AASHTO M196 and M197.

Special sections, such as elbows and flared end sections, for these conduits shall be of the same gauge as the conduit to which they are joined, and shall conform to the applicable requirements of AASHTO M196 and M197.

M.04.02.8 Smooth-Lined Corrugated Metal Pipe. Smooth-lined Corrugated Metal Pipe shall be manufactured with a smooth metal interior liner and a corrugated exterior core helically wound and lock-seamed to form a strong, integrated mechanical bond. Liner and culvert are fabricated from aluminum or galvanized steel and may be asphalt coated or uncoated as shown on the Plans. The gauge of the outer core shall conform to AASHTO M36 for galvanized metal pipe and AASTHO M196 for aluminum alloy pipe.

Special sections, such as elbows and flared end sections, for these conduits shall be of the same gauge as the conduit to which they are joined, and shall conform to the applicable requirements of AASHTO M36 and M196.

M.04.02.9 Cast Iron Soil Pipe. Cast iron soil pipe shall conform to ASTM A74.

M.04.02.10 Pipe Joints.

a. Joint Mortar. Pipe joint mortar shall conform to the requirements of **Subsection M.04.03.5** of this Section.

b. Rubber Gaskets. The ring gaskets shall conform to the requirements of AASHTO M198.

c. Oakum. Oakum for joints shall be made of hemp line, thoroughly corded and finished, and free from lumps and dirt.

d. Bituminous Joint Materials. Bituminous joint materials shall conform to **Subsection M.03.02.1** of these Specifications.

M.04.03 CATCH BASINS, MANHOLES, DROP INLETS, PAVED WATERWAYS AND MISCELLANEOUS SMALL STRUCTURES. The materials used for the construction of catch basins, manholes, drop inlets and paved waterways shall conform to the following requirements.

M.04.03.1 Clay Brick. Brick shall conform to the requirements of one of the following Specifications:

Sewer Brick: AASHTO M91, Grade SS or SM.

Building Brick: AASHTO M114, Grade SW.

M.04.03.2 Bituminous Concrete for Paved Waterways. This material shall conform to the mix requirements for Type I-2 pavement specified in **Subsection M.03.01** of these Specifications.

M.04.03.3 Concrete Masonry Blocks. Concrete masonry blocks may be rectangular or segmented and, when specified, shall have ends shaped to provide interlock at vertical joints. The blocks shall conform to the requirements of ASTM C139. Dimensions and tolerances shall be as individually specified.

M.04.03.4 Hydrated Lime. Hydrated lime shall conform to the latest requirements of ASTM C207, Type N.

M.04.03.5 Mortar. Mortar shall consist of one (1) part masonry cement, Type N, two (2) parts sand and, if required by the Engineer, hydrated lime not to exceed 10 percent by volume of the cement used. Mortar sand shall conform to the requirements of AASHTO M45. Mortar shall be used within 45 minutes after its preparation.

M.04.03.6 Frames, Grates and Covers, and Ladder Rungs. Metal units shall conform to the plan dimensions and to the following Specification requirements for the designated materials.

a. Gray Iron Castings shall conform to the requirements of AASHTO M105. Strength class shall be optional unless otherwise designated.

b. Carbon-steel Castings shall conform to the requirements of AASHTO M103. Grade shall be optional unless otherwise designated.

c. Structural Steel shall conform to the requirements of ASTM A283, Grade B or better.

d. Galvanizing, where specified for these units, shall conform to the requirements of AASHTO M111.

e. Malleable Iron Castings shall conform to the requirements of ASTM A47. Grade shall be optional unless otherwise designated.

M.04.03.7 Concrete and Steel Reinforcing. These materials shall conform to the requirements specified herein under **SECTION M.02; PORTLAND CEMENT CONCRETE** and **SECTION M.05; METALS**.

SECTION M.05

METALS

Mill Test Reports. The Contractor shall furnish certified copies in quadruplicate of mill test reports of metals used in the work. The finished metal products shall be properly marked and identified for easy correlation with the mill test reports. The chemical and physical properties of each heat of steel used shall conform to all the requirements of the relevant AASHTO or ASTM Specifications.

M.05.01 BAR REINFORCEMENT. All reinforcement shall be furnished as indicated on the Plans. Reinforcing bars shall be deformed except that plain bars may be used for spirals and ties. They shall be fabricated from new billet steel and shall conform to AASHTO M31 (ASTM A615). The grade shall be 60 unless otherwise shown on the Plans.

M.05.02 WIRE REINFORCEMENT.

M.05.02.1 Wire Fabric. All steel wire fabric shall conform to either AASHTO M55 (ASTM A185) or AASHTO M221 (ASTM A497) for plain and deformed wire fabric, respectively.

M.05.02.2. Spiral Wire. Spiral wire reinforcement shall conform to AASHTO M32 (ASTM A82).

M.05.03 PRESTRESSING STEEL. Prestressing steel shall be high-strength steel wire, high-strength, seven-wire strand or high-strength alloy bars of the grade and type called for on the Plans or in the Special Provisions.

M.05.03.1 Products.

a. Wire shall be high-strength stress relieved uncoated steel wire conforming to AASHTO M204 (ASTM A421).

b. Strand shall be high-strength seven-wire low relaxation uncoated strand conforming to the requirements of AASHTO M203 (ASTM A416).

c. Bars shall be high-strength uncoated alloy bars conforming to AASHTO M275 (ASTM A722).

M.05.04 STRUCTURAL STEEL. All steels for use in main load carrying member components subject to tensile stress shall conform to the applicable Charpy V-Notch Impact Test requirements of AASHTO M270 (ASTM A709).

M.05.04.1 Products.

a. Carbon Steel and Foundation Pilings shall conform to AASHTO M270 (ASTM A709) Grade 36.

b. High-Strength Low-Alloy Steel shall conform to AASHTO M270 (ASTM A709) Grade 50 or Grade 50W.

c. High-Strength Low-Alloy Structural Steel Plate Quenched and Tempered shall conform to AASHTO M270 (ASTM A709) Grade 70W.

d. High-Yield Strength, Quenched and Tempered, Low-Alloy Steel Plate shall conform to AASHTO M270 (ASTM A709) Grades 100 or 100W.

M.05.04.2 Steels for Pins, Rollers, and Expansion Rockers.

a. Steel Bars, Carbon Cold Finished Standard Quality shall conform to AASHTO M169 (ASTM A108) Grades 1016 to 1030 inclusive for sizes 4 inches in diameter or less.

b. Steel Forgings, Carbon and Alloy for General Industrial Use shall conform to AASHTO M102 (ASTM A668) Class F for sizes to 10 inches in diameter and classes C, D, and G for sizes to 20 inches in diameter.

M.05.04.3 Structural Tubing shall be either cold formed welded or seamless tubing conforming to ASTM A500 Grade B or hot-formed welded or seamless tubing conform to ASTM A501.

M.05.04.4 Fasteners - Bolts.

a. Carbon-Steel Bolts shall conform to ASTM A307.

b. High Strength Bolts for structural steel joints shall conform to either AASHTO M164 (ASTM A325) or AASHTO M253 (ASTM A490). When high strength bolts are used with unpainted weathering grades of steel, the bolts shall be Type 3.

The supplier shall provide a lot number appearing on the shipping package and a certification noting when and where all testing was done, including rotational capacity tests, and zinc thickness when galvanized bolts and nuts are used.

The maximum hardness for AASHTO M164 (ASTM A325) bolts 1 inch or less in diameter shall be 33 HRC.

1. Proof Load Tests (ASTM F606 Method 1) are required for the bolts. Wedge tests of full size bolts are required in accordance with Section 8.3 of AASHTO M164. Galvanized bolts shall be wedge tested after galvanizing. Proof load tests (AASHTO M291) are required for the nuts. The proof load tests for nuts to be used with galvanized bolts shall be performed after galvanizing, over-tapping and lubricating.

Except as noted below, nuts for AASHTO M164 (ASTM A325) bolts shall conform to AASHTO M291 (ASTM A563) Grades DH, DH3, C, C3 and D or AASHTO M292 (ASTM A194) Grades 2 and 2H. Nuts for AASHTO M253(ASTM A490) bolts shall conform to the requirements of AASHTO M291 (ASTM A563) Grades DH and DH3 or AASHTO M292 (ASTM A194) Grade 2H.

Nuts to be galvanized (hot-dip or mechanically galvanized) shall be heat treated Grade 2H, DH or DH3.

Plain (ungalvanized) nuts shall have a minimum hardness of 89 HRB.

Nuts to be used with AASHTO M164 (ASTM A325;) Type 3 bolts shall be of Grade C3 or DH3. Nuts to be used with AASHTO M253 (ASTM A490) bolts shall be of Grade DH3.

All galvanized nuts shall be lubricated with a lubricant containing a visible dye. Black bolts must be oily to touch when delivered and installed.

Washers shall be hardened steel washers conforming to the requirements of AASHTO M293 (ASTM F436).

2. Identifying Marks. AASHTO M164 (ASTM A325) for bolts and the specifications referenced therein for nuts require that bolts and nuts manufactured to the specification be identified by specific markings on the top of the bolt head and on one face of the nut. Head markings must identify the grade by the symbol "A 325," the manufacturer and the type, if Type 2 or 3. Nut markings must identify the grade, the manufacturer and if Type 3, the type. Markings on direct tension indicators must identify the manufacturer and Type "325." Other washer markings must identify the manufacturer and if Type 3, the type.

AASHTO M253 (ASTM A490) for bolts and the specifications referenced therein for nuts require that bolts and nuts manufactured to the specifications be identified by specific markings on the top of the bolt head and on one face of the nut. Head markings must identify the grade by the symbol "A 490," the manufacturer and the type, if Type 2 or 3. Nut markings must identify the grade, the manufacturer and if Type 3, the type. Markings on direct tension indicators must identify the manufacturer and Type "490." Other washer markings must identify the manufacturer and if Type 3, the type.

3. Dimensions. Bolt and nut dimensions shall conform to the requirements for Heavy Hexagon Structural Bolts and for Heavy Semi-Finished Hexagon Nuts given in ANSI Standard B18.2.1 and B18.2.2, respectively.

d. Galvanized High-Strength Fasteners. When fasteners are galvanized, they shall be specified to be hot-dip galvanized in accordance with AASHTO M 232 (ASTM A153) Class C or, mechanically galvanized in accordance with AASHTO M298 (ASTM B695) Class 50. Bolts to be galvanized shall be either AASHTO M164 (ASTM A325) Type 1 or Type 2 except that Type 2 bolts shall only be mechanically galvanized. Galvanized bolts shall be tension tested after galvanizing.

Washers, nuts and bolts of any assembly shall be galvanized by the same process. The nuts should be over-tapped to the minimum amount required for the fastener assembly, and shall be lubricated with a lubricant containing a visible dye so a visual check can be made for the lubricant at the time of field installation. AASHTO M253 (ASTM A490) bolts shall not be galvanized.

e. Alternative Fasteners. Other fasteners or fastener assemblies which meet the materials, manufacturing, and chemical composition requirements of AASHTO M 164 (ASTM A325) or AASHTO M253 (ASTM A490), and which meet the mechanical property requirements of the same specification in full-size tests, and which have body diameter and bearing areas under the head and nut, or their equivalent, not less than those provided by a bolt and nut of the same nominal dimensions prescribed in **Para. b.3** of this **Subsection M.05.04.4** may be used, subject to the approval of the Engineer. Such alternate fasteners may differ in other dimensions from those of the specified bolts and nuts.

Subject to the approval of the Engineer, high-strength steel lock-pin and collar fasteners may be used as an alternate for high strength bolts as shown on the Plans. The shank and head of high-strength steel lock-pin and collar fasteners shall meet the requirements of **Para. b.3** of this **Subsection M.05.04.4.**

Each fastener shall provide a solid shank body of sufficient diameter to provide tensile and shear strength equivalent to or greater than that of the bolt specified, shall have a cold forged head on one end, of type and dimensions as approved by the Engineer, a shank length suitable for material thickness fastened, locking grooves, breakneck groove and pull grooves (all annular grooves) on the opposite end. Each fastener shall provide a steel locking collar of proper size for shank diameter used which, by means of suitable installation tools, is cold swaged into the locking grooves forming head for the grooved end of the fastener after the pull groove section has been removed. The steel locking collar shall be a standard product of an established manufacturer of lockpin and collar fasteners, as approved by the Engineer.

M.05.04.5 Weld Metal shall conform to the current requirements of the ANSI/AASHTO/AWS D1.5 Bridge Welding Code.

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. Independent Assurance 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.

M.05.04.7 Low Alloy Nickel Copper Steel Pipe (Corrosion Resistant). This pipe shall be manufactured subject to the requirements of ASTM A53; "Welded and Seamless Steel Pipe" with the following modifications:

Carbon	0.20% maximum
Manganese	1.06% maximum
Phosphorous	0.08% maximum
Sulphur	0.05% maximum
Copper	0.75 to 1.25%
Nickel	1.60 to 2.20%

M.05.04.8 Steel Forging and Steel Shafting.

a. Steel Forgings shall conform to the Specification for Steel Forgings, carbon and alloy, for General Use, AASHTO M102 (ASTM A668, Class C, D, F, or G.

b. Cold Finished Carbon Steel Shafting shall conform to AASHTO M169 (ASTM A108) Grade 10160-10300 inclusive unless otherwise specified.

M.05.04.9 Steel Castings and Iron Castings.

a. Steel Castings for use in highway bridge components shall conform to AASHTO M192 (ASTM A486).

Carbon-Steel Castings for general applications shall conform to AASHTO M103 (ASTM A27), Class 70 or Grade 70-36 steel, respectively, unless otherwise designated.

b. Chromium Alloy-Steel Castings shall conform to the Specification for Corrosion-Resistant Iron Chromium, Iron-Chromium-Nickel and Nickel-Based Alloy Castings for General Applications, AASHTO M163 (ASTM A743) Grade CA 15, unless otherwise specified.

c. Gray-Iron Castings shall conform to the Specification for Gray-Iron Castings, AASHTO M105 Class No. 30, unless specified otherwise.

d. Ductile Iron Castings for scupper grates shall conform to the requirements of ASTM A536.

e. Malleable Iron Castings shall conform to the Specification for Malleable Iron Castings, AASHTO M 06. The grade to be furnished shall be number 32510, unless otherwise specified.

f. Iron Castings shall be true to pattern in form and dimensions, free from pouring faults, sponginess, cracks, blow holes, and other defects in position affecting their strength and value for the service intended. Castings shall be boldly filleted at angles and the arrises shall be sharp and perfect.

g. All Castings must be blast-cleaned or otherwise effectively cleaned of scale and sand so as to present a smooth, clean, and uniform surface.

M.05.04.10 Bronze or Copper-Alloy.

a. Bronze Castings shall conform to the requirements of AASHTO M107 (ASTM B22).

b. Copper-Alloys 913 or 911, or Copper-Alloy Plates shall conform to the requirements of AASHTO M108 (ASTM B100).

M.05.04.11 Aluminum Materials. Aluminum materials for structures, signs, sign and signal supports, lighting, hardware and welding materials shall conform to the specifications listed as follows:

a. Sheet and Plate Aluminum shall conform to ASTM B209, Alloy 5456-M116 for thicknesses from 0.188 inch to 1.25 inches.

b. Plate Aluminum shall conform to ASTM B209 Alloy 5086-M116 for thicknesses from 0.250 inch to 2.000 inches.

c. Extruded Aluminum Bars, Rods, Shapes and Tubes for all thicknesses shall conform to ASTM B221.

d. Aluminum Bars, Rods, and Wire for Pins, Rollers, and Expansion Rockers. When aluminum is used for pins, rollers or expansion rockers, it shall conform to the requirements of ASTM B211 Alloy 6061-T6.

e. Fasteners, Rivets and Bolts. Fasteners for aluminum connectors may be coated carbon steel bolts, ASTM A307; power driven aluminum rivets ASTM B316 Alloy 6061-T6 conforming to the requirements of MIL-R-1150F; coated high strength steel bolts AASHTO M164 (ASTM A325), or stainless steel bolts ASTM F593 Group 1, 2, or 3.

f. Weld Metal. Weld metal shall conform to the requirements of American Welding Society's AWS D 1.2 Structural Welding Code - Aluminum.

g. Aluminum Castings. Aluminum permanent mold castings shall conform to the requirements of ASTM B108 Alloy A 4440-T4. Sand castings shall conform to ASTM B26.

h. Aluminum Forgings. Aluminum forgings and forging stock shall conform to the requirements of ASTM B247 Alloy 6061-T6.

i. Seamless Pipe and Seamless Extruded Tube shall conform to the requirements of ASTM B241.

j. Aluminum for Standard Structural Shapes shall conform to the requirements of ASTM B308.

k. Extruded Structural Pipe and Tubing shall conform to the requirements of ASTM B429.

M.05.04.12 Structural Materials for Corrugated Metal Structures. Materials shall conform to the following specifications:

a. Corrugated Metal Pipe and Pipe Arches shall conform to the requirements of AASHTO M36 (ASTM A760); AASHTO M245 (ASTM A762) or AASHTO M190 for steel and AASHTO M196 (ASTM B745) for aluminum.

b. Spiral Rib Metal Pipe shall conform to the same requirements as corrugated metal pipe.

c. Structural Plate Pipe. Structural plate pipe, pipe arches, and arch structures or culverts shall conform to the requirements of AASHTO M167 (ASTM A761) for steel and AASHTO M219 (ASTM B746) for aluminum.

M.05.04.13 Hardware for Timber Construction. The term hardware shall include all metal fastenings required for timber connections or for connecting timber to concrete or steel work. The following items will be considered as Hardware: bolts, tie rods, turnbuckles, washers, nuts, drift bolts, steel dowels, nails, spikes and lag screws for timber connections; steel plates used as washers; metal timber connectors of various designs; metal shear developers for composite timber and concrete structures; and anchor plates or clips for plank floors and sidewalks.

a. Steel Components. Rods, plates, eyebars, and shapes shall conform to the requirements of AASHTO M270; Structural Steel for Bridges, Grade 36 unless otherwise specified in the Special Provisions.

b. Hardware. Bolts, nuts, drift bolts, dowels, and washers may be fabricated of mild carbon steel unless otherwise specified in the Special Provisions. Washers may be cast iron or malleable iron castings.

c. Timber Connectors. Split rings as manufactured in 2½-inch and 4-inch diameters shall be fabricated of hot-rolled carbon steel that conforms to the requirements of Society of Automotive Engineers Specification SAE-1010.

Shear plates shall be fabricated of hot-rolled carbon steel that conforms to the requirements of SAE-1010 for 2⅝-inch diameter plates. Shear plates shall be fabricated of malleable cast iron; Grade 32510, in accordance with ASTM A47 for 4-inch diameter plates.

Spike grid connectors shall be fabricated of malleable cast iron; Grade 32510, in accordance with ASTM A47.

d. Miscellaneous Requirements. Bolts shall have either standard square, hexagonal, or dome heads, or economy type (washer) heads. Unless otherwise specified, bolts shall conform to ASTM A307; "Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile." They shall have coarse threads, Class 2 tolerance, that conform to ANSI Standard Specifications.

Nails shall be cut or round wire of standard forms. Spikes shall be cut or wire spikes, or boat spikes, as specified in the Special Provisions.

e. Galvanizing. Unless otherwise specified in the Special Provisions, all hardware and steel components shall be galvanized. Hardware shall be galvanized in accordance with AASHTO M232; "Zinc Coating (Hot-Dip) on Iron and Steel Hardware." Other steel components shall be galvanized in accordance with AASHTO M111; "Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars and Strip."

M.05.05 EPOXY COATING FOR BAR REINFORCEMENT. Epoxy coatings shall conform to AASHTO M284 (ASTM D3963).

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 may also be galvanized mechanically in accordance with AASHTO M298 (ASTM B695) Class 50.

M.05.07 METALIZING. Structural steel shall be metalized in accordance with C2.2, Recommended Practices for Metalizing with Aluminum and Zinc for protection of Iron and Steel of the American Welding Society.

M.05.07.1 Materials. All materials shall conform to the following requirements:

All coating shall meet current VOC emission requirements of the EPA Clean Air Act of 1977.

M.05.07.2 Blast Abrasive. Material shall be fresh, dry and sharp. The grain size shall be such as to provide a surface profile of 2.0 to 4.0 mils (approximately 30 to 70 mesh). In no case may round, soft sand be used. Samples of the abrasive shall be submitted to and approved by the Engineer prior to the commencement of any work.

M.05.07.3 Wire. The wire used for spraying required herein shall be pure zinc or an alloy consisting of 85 percent zinc 15 percent aluminum by weight drawn to manufacturer's recommendation for compatibility with equipment being used. For chemical composition, see Military Specification MIL-W-6712.

SECTION M.06

PAINT

M.06.01 GENERAL. All paints shall be factory mixed to comply with the specification formula for the type of paint ordered; shall be well ground to a uniform consistency and smooth texture; shall be free from dirt, water and other foreign matter; and shall dry within the specified period without running, streaking or sagging. Any paint which, prior to shipment, shall have livered, or in any way hardened or thickened in the container, or in which the pigment shall have settled out so that it cannot be readily broken up with a paddle to a smooth uniform paint of a proper consistency, shall be rejected.

There shall be no significant difference in color between batches of paint used on an individual structure. The Volatile Organic Content (VOC) shall comply with prevailing regulations.

M.06.01.1 Literature. Product data sheets shall be supplied with each of the products and shall include but not be limited to the following information:

a. Selection Data; generic type, general properties, recommended use, chemical resistance guide, temperature resistance, flexibility, weathering, abrasion resistance, substrates, topcoats required, and compatibility with other coating.

b. Specification Data; solids by volume of the mixed materials, recommended thickness per coat, theoretical coverage per mixed gallon, shelf life, special notes, colors, and gloss.

c. Ordering Information; shipping weights of the product, thinners, and flash points of each.

d. Application Instructions; surface preparation for appropriate substrates, mixing instructions, pot life for catalyzed materials, application temperatures, instructions for application by spray including equipment recommendations, instructions for application by brush and roller if applicable, drying times, cleanup recommendations, and storage conditions.

e. Compositional Data Sheets shall be provided which list the percent pigment by weight of mixed material, and percent by weight of the vehicle, non-volatile portion of the vehicle. This sheet shall also categorize the solvent according to type and whether they are photo reactive.

f. Solvent Identification Sheets shall indicate a listing of the volatile portions of vehicle and categorize solvents by type and photochemical reactivity.

g. Product Certification shall be provided on materials used to meet State Department of Transportation Specifications.

h. Material Safety Data Sheets (MSDS) shall be provided to the Contractor and Engineer with all materials and shall accompany the material when shipped so the person receiving the material is aware of the hazards presented by the product and of appropriate storage requirements

for these materials. Additional copies of the MSDS shall be available upon request.

M.06.01.2 Shipping and Delivery. All paint shall be delivered to the shop or jobsite in their original containers, unopened, and with labels intact.

All paints shall be supplied by the same manufacturer.

The Contractor/fabricator shall insure that sufficient quantities of paint are ordered. The top coat shall be applied with paint that is entirely from the same lot or batch number.

Unless otherwise specified, all paint furnished shall be delivered in metal containers, minimum 5 U.S. Standard gallons each, except for small quantities, when one-gallon containers may be used.

All containers shall be labeled in accordance with ANSI Standard Z129.1 "Precautionary ..."

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.06.01.3 Sampling. Whenever possible, inspection and sampling shall be made at point of manufacture. Manufacturer shall furnish all necessary assistance and opportunity to sample the paint. The plant sample shall be termed the batch sample which shall become the base fingerprint to which the field samples will be compared. Field samples shall be taken from the paint that is on the project.

No paint shall be applied until it has been approved by the Department. Paint which has not been used within 6 months after its approval date shall be retested prior to use. 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.

Any paint which is rejected as a result of field evaluation shall be removed from the project before any painting operations can continue.

M.06.02 PAINT SYSTEMS. The paint shall be selected from either the Department's Approved Materials List, or as specified in Special Provision Code 825.1000. Before proceeding with painting, the Contractor shall submit samples, chemical analysis, color or paint to be used, and plan of painting to be followed, or other data as the Engineer may direct to enable him to grant approval.

SECTION M.07

SHEET PILING AND PILES

M.07.01 UNTREATED TIMBER SHEET PILING. Timber sheeting shall be sound spruce, Douglas fir, white or yellow Lodgepole or Ponderosa pine, or western hemlock plank, planed on one side and either tongue and grooved or splined. Timber sheeting shall not be less than nominal 4 inches thick. The properties of timber sheeting shall conform to the requirements of AASHTO M168; Structural Timber, Lumber, and Piling.

M.07.02 TREATED TIMBER SHEET PILING. Treated timber sheet piling shall conform to the requirements for untreated sheet piling as set forth above in **Subsection M.07.01**. In addition, treated sheet piling shall conform to the requirements of AASHTO M133, and current EPA and RIDEM regulations.

M.07.03 PRECAST CONCRETE SHEET PILING. Concrete sheet piling shall conform to the applicable requirements of **SECTIONS 601 and 809; PORTLAND CEMENT CONCRETE and PRECAST/PRESTRESSED STRUCTURE CONCRETE MASONRY**, respectively, of these Specifications.

M.07.04 STEEL SHEET PILING. Steel sheet piling shall be rolled steel sections and shall conform to the requirements of AASHTO M270, Grade 36, unless otherwise specified.

M.07.05 UNTREATED TIMBER PILES.

M.07.05.1 General. Timber piles shall conform to the requirements of AASHTO M168 and shall be cut from sound and live trees, preferable during the winter season. Piles shall be free from any defects which will impair their strength or usefulness for the purpose intended or that will prevent proper driving.

Unless otherwise specified, untreated timber piles shall have the bark unpeeled. Treated timber piles shall be clean-peeled so that all of the outer bark and at least 80 percent of the inner bark well distributed over the outer surface of the pile shall be removed. In order to obtain proper preservative treatment, no strips of inner bark wider than ½-inch shall remain.

All piles shall be cut above the ground swell, shall have a uniform taper from butt to tip end, and shall be free from short kinks. Knots or blemishes shall be trimmed off close and even with the body of the pile. A line from the center of the butt to the center of the tip must lie wholly within the body of the pile.

M.07.05.2 Inspection. All piles will be subject to inspection before or after shipment to the site, or both, at the option of the Engineer. Any pile that does not conform to all the requirements will be rejected.

M.07.05.3 Specific Requirements. Untreated piles shall be new spruce, oak, Douglas fir, yellow pine, or any other species, subject to the approval of the Engineer, which will withstand the specified driving without injury.

Butt and tip dimension for various lengths of piles shall be as set forth in the following table:

Length	Minimum Dimension 3 Feet from Butt	Minimum Tip Dimension
Up to 40 feet	12 inches	8 inches
40 feet and up to 50 feet	12 inches	7 inches
50 feet and over	13 inches	6 inches

For all piles the maximum dimension 3 feet from the butt shall be 20 inches. Measurements are under the bark in all cases. Where the piles are to support a concrete cap, the maximum butt dimensions shall be 6 inches less than the designated width of the concrete cap.

Where piles are to be in line in a bent, all piles in the bent shall be of uniform size to permit the proper fastening of the bracing. Cutting of piles to accommodate the bracing will not be permitted.

M.07.06 TREATED TIMBER PILES. Treated timber piles shall conform to the requirements as set forth above in **Subsections M.07.05.1** and **M.07.05.2**.

M.07.06.1 Specific Requirements. Timber to be used for treated piles will be southern yellow pine or Douglas fir and shall be treated in accordance with AWPA Standard C3 for C.C.A. All piles for which treatment is specified shall have not less than 1 inch of sapwood at the butt end for Douglas fir and a 2-inch ring of sapwood at the butt end for southern pine. Preservative treatment shall conform to the requirement of AASHTO M133 and the method of treatment shall conform to American Wood Preservers Association Standards C1, C2, and C3.

M.07.07 PRECAST-PRESTRESSED CONCRETE PILES. Unless specified otherwise, precast-prestressed concrete piles shall be standard 14-inch square piles designed and manufactured in accordance with the Joint AASHTO and PCI Committee recommendations. Precast-prestressed concrete piles shall also conform to the applicable requirements of **SECTIONS 601 and 809; PORTLAND CEMENT CONCRETE and PRECAST/PRESTRESSED STRUCTURE CONCRETE MASONRY**, respectively, of these Specifications.

M.07.08 CONCRETE-FILLED SHELL PILES. This Subsection covers steel shell type piles where the shell is not considered as a permanent load carrying member.

M.07.08.1 Steel Shells. Steel shells shall be of sufficient strength and rigidity to permit driving and to prevent distortion caused by soil pressures or the driving of adjacent piles, until filled with concrete. The shells shall be sufficiently watertight to exclude water during the placing of concrete.

Steel shells shall have a uniform taper, or a combination of uniform sections of increasing diameter, or a combination of uniform sections of equal length that increase progressively not more than twice the thickness of the shell at each change in diameter, or a uniform section throughout; but only one type shall be used for the Contract. The tip shall be of steel fully welded to tightly close the bottom of the pile to make a watertight closure. Care must be exercised to avoid the use of more than one short section at the butt end when necessary to extend the pile length.

If steel shells consisting of a succession of cylindrical sections of increasing diameter are used, all sections shall be of equal length and increasing in diameter by not more than one inch between adjoining sections from the section at the tip to the section at the butt of the pile.

The minimum tip diameter shall be 8 inches. The minimum butt diameter at the point of cut-off shall be 12 inches when the specified loading is 40 tons or less, or shall be 14 inches when the specified loading is over 40 tons and less than 50 tons.

M.07.08.2 Concrete. Concrete for concrete-filled shell piles shall be Class A(AE) and shall otherwise conform to the applicable requirements of **SECTION 601; PORTLAND CEMENT CONCRETE**, of these Specifications. Reinforcement shall conform to the requirements of **Subsection M.05.01; Bar Reinforcement**, of these Specifications.

M.07.09 STEEL H-PILES. Steel H-piles shall be rolled structural shapes conforming to the requirements of AASHTO M270, Grade 36, unless otherwise specified.

M.07.10 STEEL PIPE PILES. This Subsection covers steel piles where the casing is considered a permanent load-carrying member. Steel for pipe piles shall conform to the Standard Specifications for Welded and Seamless Steel Pipe Piles, ASTM A 252, Grade 2.

M.07.11 PILE POINTS AND DRIVE SHOES shall be carbon-steel castings that conform to the requirements of AASHTO M103 (ASTM A27), Class 70 or Grade 70-36.

M.07.12 CLOSURE PLATES AND CAPS shall be mild carbon steel that conforms to the requirements of AASHTO M270 (ASTM A709), Grade 36.

SECTION M.08

FENCE AND GUARDRAIL

M.08.01 BARBED WIRE. Barbed wire shall conform to the requirements of ASTM A121.

M.08.02 CHAIN LINK FENCE. Chain link fence and required fittings and hardware shall conform to the requirements of AASHTO M181 for the kind of metal, coating, sizes of wire and mesh specified.

M.08.02.1 Fence, Woven Wire, Right-of-Way. Right-of-way wire fencing shall conform to AASHTO M279, Class 3, Grade 60.

M.08.03 METAL BEAM RAIL. The rail elements shall be corrugated sheet steel beams conforming to the requirements of AASHTO M180 Class A; Type II.

M.08.04 TIMBER RAIL. The timber rail shall be cut from the specified grade for dry, well seasoned and dressed spruce or fir, which shall meet the applicable requirements of AASHTO M168.

Where preservative treatment is specified this shall conform to the requirements for "Preservative Treatments for Timber" of the AASHTO Standard Specifications for Highway Bridges. Timber preservatives shall conform to the requirements of AASHTO M133.

M.08.05 WIRE CABLE. The wire cable for guardrail shall conform to the requirements of AASHTO M 30 for the specified diameter and strength class.

Flexible rail elements composed of multiple wires in any arrangement other than cable form shall conform in all respects to the Plan details and dimensions, and to the strength requirements on the Specifications for the item.

M.08.06 FENCE POSTS. Wood posts shall conform to the details and dimensions indicated on the Plans. All wood posts shall be of sound, seasoned chestnut or cedar, peeled and with ends cut square or as indicated on the Plans. Posts shall conform to AASHTO M168. The posts shall be straight and all knots trimmed flush with the surface. Where treated posts are called for, the kind and type of treatment shall conform to AASHTO M133.

All dimension timber and lumber required for fences or gates shall be sound, straight and free from knots, splits and shakes, and shall conform to AASHTO M168. It shall be of the species and grades indicated on the Plans and shall be dressed and finished on four sides.

Steel posts shall be galvanized in accordance with AASHTO M 111. Fittings, hardware and other appurtenances not specifically covered by the Plans and Specifications shall be standard commercial grade, and in accord with current standard practice.

M.08.07 GUARDRAIL POSTS. Railing posts shall be of either wood, steel or concrete as may be specified or shown.

M.08.07.1 Wood Posts. Wood posts shall be fabricated from an approved or specified timber species and shall be of the quality, diameter or section, and length as specified or as shown on the Plans. When treated posts are specified, they shall be fabricated before treatment. Timber

preservatives and preservative treatment shall conform to the requirements of **Subsection M.08.04**.

M.08.07.2 Steel Posts. Steel posts shall be of the section and length specified or as shown on the Plans. They shall be of copper bearing steel when so specified. Steel shall conform to the requirements of AASHTO M183 for the grade specified, or, for new railroad rail posts, of ASTM A1 for the unit weight of rail specified.

The posts shall be galvanized to conform with AASHTO M111.

M.08.07.3 Precast Reinforced Concrete Posts shall be of a section and length as specified or as shown on the Plans. Concrete shall be Class XX(AE) and shall conform to the applicable requirements of both **SECTIONS 601** and **M.02; PORTLAND CEMENT CONCRETE**, of these Specifications. Bar reinforcement shall conform to **Subsection M.05.01** of these Specifications.

M.08.07.4 Concrete Deadmen for end anchorages shall be as specified or as shown on the Plans. Concrete shall be Class XX(AE) and shall conform to the applicable requirements of both **SECTIONS 601** and **M.02; PORTLAND CEMENT CONCRETE**, of these Specifications. Bar reinforcement shall conform to **Subsection M.05.01** of these Specifications.

M.08.08 GUARDRAIL HARDWARE. Offset brackets of the resilient and non-resilient types shall be of the type specified or as shown on the Plans, and shall meet the strength requirements specified.

Splices and end connections shall be of the type and design specified or shown on the Plans, and shall be of such strength as to develop the full design strength of the rail elements.

End spring assemblies, when specified, shall be positive and of a type and design coinciding with the intent, design and strength of the railing structure, and shall be as specified or as shown on the Plans.

End anchor rods and accessories shall be as specified or as shown on the Plans and shall be of such size and strength as to develop the full design strength of the rail elements.

Unless otherwise specified, all fittings, bolts, washers and other accessories shall be galvanized in accordance with the requirements of AASHTO M111. All galvanizing shall be done after fabrication.

Steel Beam Guardrail Reflectorized Triangular Delineators shall be of the type specified on the Plans. All triangular delineators shall be approved by the Department's Product Evaluation Committee and shall be one of those products contained in the Department's Approved Materials List.

The washers of the delineator shall conform to the requirements for ASTM B209 Alloy 5052-H-32.

SECTION M.09

CURBING

M.09.01 GRANITE CURB FOR ROADWAYS. Granite shall conform to ASTM C615. The stone shall be sound, durable and free from seams; they shall be straight lined, without wind, and free from bunches or depressions; and shall not be taken from the surface of the quarry. The top of the stone shall be sawed to an approximately true plane, with no projections or depressions greater than 1/4-inch in any one piece. The front and back arris lines shall be pitched straight and true. There shall be no projections on the back face for 3 inches down from the top greater than 1/4-inch.

Circular curb to be set on a radius of 160 feet or less shall be cut to the lengths and radii shown on the Plans, and shall conform in every respect to the requirements of these Specifications.

The top surface of curbing shall be free from drill holes and shall be scabble dressed to an approximately true plane with no projections or depressions greater than ½-inch. The front arris line shall be such that, when a straightedge is applied to the full length of the curb stone, there shall be no depressions under the straightedge greater than ½-inch.

The front face shall be at right angles to the plane of the top and shall be smooth quarry split, free from drill holes which are longer than 3½-inches plus or minus 1/4-inch and deeper than ½-inch and with no projections greater than 3/4-inch or depressions greater than ½-inch measured from the vertical plane of the face through the top arris line for a distance of 8 inches down from the top.

The ends of all curbing shall be jointed square with the planes of the top and face and so finished that when stones are placed end to end as closely as possible no space greater than 3/4-inch will show in the joint for the full width of the top or down on the face for 8 inches, after which the end may break back no more than 8 inches. The arris line formed by the intersection of the plane of the joint with the planes of the top and exposed faces shall have no variations from the plane of the top and exposed faces greater than 1/4-inch.

M.09.02 GRANITE SLOPE CURBING FOR ROADWAYS. Granite shall conform to ASTM C615. The curbstone shall be of hard and durable granite of a uniformly light grayish white color and satisfactory to the Engineer, free from seams which would impair its structural integrity, and of a good smooth splitting appearance. The straight slope curbing shall be in lengths of not less than 2 feet or more than 6 feet. When the slope curbing is used on a curve of 100 feet radius or less, the length shall be as directed by the Engineer, except that when the edging is to be set on a radius of 10 feet or less, the maximum length shall be 1 foot. The curbing shall have a minimum thickness of 3 inches and a maximum thickness of 6 inches.

When the slope curbing is set, the width of the face of the curbing shall be 12 inches, with a tolerance of plus or minus 1 inch. The exposed face of all curbing shall be smooth quarry split to an approximate true plane and shall have no projections or depressions which will cause over 1 inch to show between a 2-foot straightedge and the face when the straightedge is placed as closely as possible on any part of the face. If projections on the face are more than that specified, they shall be dressed off. The top and bottom lines of the face shall be pitched off to a straight line

and shall not show over 1-inch between stone and straightedge when straightedge is placed along the entire length of top and bottom lines when viewed from a direction at right angles to the plane of the face, and for the top line only not over 1-inch when viewed from a direction in the plane of the face. The ends shall be square to the plane of the face and so finished that when the stones are placed end to end as closely as possible, no space more than 1½-inches shall show in the joint for the full width of the face except that where the edging is to be used on a curve having a radius of 10 feet or less, the ends of the stone shall be cut so as to provide a finished joint for the full width of the face of not more than 3/4-inch. The arris lines at the ends shall be pitched with no variation from the plane of the face more than 1/4-inch. Drill holes not more than 3½-inches or ½-inch in depth will be permitted. The sides shall not be under the square more than 4 inches or over the square at the back more than 1 inch.

M.09.03 PRECAST CONCRETE CURBING. The curbing shall conform to the dimensions indicated on the Plans. The concrete shall conform to the requirements of **SECTION 601; PORTLAND CEMENT CONCRETE**.

Forms for the curbing shall be of wood or metal, or approved sand molds preformed with suitable moulding sand. Sand molds shall be constructed as directed by the Engineer and shall conform to the dimensions as specified on the Plans. All surfaces shall be clean cut, free from blow holes or pitted areas. Sand molds shall be sprayed with approved wax solution if required by the Engineer. When sand molds are used the curbing shall be removed from the sand forms as directed by the Engineer.

With the slope faced curbing the top, slope and vertical faces shall be floated smooth and the edges rounded to remove the sharp corners while the curb is still soft. Caution shall be used to remove only the sharp edges. The curbing shall then be finished as indicated on the Plans or in the Proposal.

Slope faced curbing with white faced top and slope shall be poured in two courses as indicated on the Plans. The second course shall be poured immediately after completion of pouring the first course in order that a sufficient bond between the 2 courses shall be obtained. The use of a standard white Portland cement will be required for the upper portion of the slope and top faces of the curbing. Manipulation and finishing shall be as indicated in these Specifications and as indicated on the Plans or in the Proposal.

Dog-holes shall be moulded in sections as shown on the Plans.

M.09.03.1 Reinforcement. Reinforcing materials, if and as called for, shall conform to the requirements specified under **Subsection M.05.01; Bar Reinforcement**.

M.09.03.2 Joint Fillers. Preformed and poured joint fillers, if and as called for, shall conform to the requirements specified under **Subsection M.02.10; Joint Materials**.

M.09.04 BITUMINOUS CURBING. Bituminous concrete curbing shall conform to both the applicable requirements of **SECTION M.03** and the gradation requirements, physical properties and test limits indicated in the following table:

Sieve Size	Gradation Percent by Weight
½"	100
3/8"	90-100
#4	80-100
#8	60-82
#30	35-55
#50	22-38
#100	10-22
#200	5-12
Asphalt Percent by Weight	7-10
Marshall Stability lbs. (min.) 50 Blow	1000
Percent Voids	3-5
Flow (in.)	.08-.16

M.09.05 GRANITE CURB FOR BRIDGES. Granite shall conform to ASTM C615.

M.09.05.1 General. The stone for bridge curb shall be hard, durable granite of a uniform grayish white color, free from seams which impair its structural integrity and shall be satisfactory to the Engineer. Natural color variations characteristic of granite at the source quarry will be permitted.

M.09.05.2 Dimensions. Unless otherwise shown on the Plans, straight curb shall be furnished in lengths of not less than 6 feet or preferably more than 8 feet, but in no case more than 10 feet, and shall be of approximately equal lengths in any run between two consecutive joints. Detailed cutting plans shall be submitted and approved before the cutting of stone is started. Curb to be set on a radius of 160 feet or less shall be cut to the curve required.

Curb which is to be set on a radius between 160 feet and 300 feet may be furnished straight if furnished in lengths not to exceed 6 feet.

M.09.05.3 Vertical Face Granite Curb Finish. The top surface shall be sawed or tooled to an approximately true plane with no projections or depressions greater than 1/8-inch. The bottom surface shall be sawed or split to a dimensional tolerance of +0 to -1/2-inch. The front and back arris lines shall be pitched straight and true and there shall be no projections on the back surface for 3 inches down from the top which would exceed ½-inch. The remainder of the back may fall away by not more than 1½-inches. The front face shall be at right angles to the planes of the top and ends and shall be sawed or tooled to an approximately true plane, with no projections or

depressions of more than 1/4-inch measured from the vertical plane of the face through the arris or pitch line.

The ends of all stones shall be cut square with the planes of the top and face. Ends of stones at joints where they are to be in contact with preformed joint filler must be held full for their entire depth and finished by sawing with a maximum variation of 1/4-inch. Ends of stones at intermediate joints shall be held full for 2 inches from all exposed surfaces with a permitted variation of 1/4-inch. Beyond this area the joint may fall away a maximum of 3 inches.

M.09.05.4 Slope Face Granite Curb Finish. The top face and slope face shall be sawed or tooled to an approximately true plane with no variations greater than 1/8-inch. The bottom surface shall be sawed or split to a dimensional tolerance of +0 to -1/2-inch. The face and back arris lines shall be pitched straight with no variation greater than 1/8-inch. There shall be no projections on the back surface for 3 inches down from the top which would exceed ½-inch. The remainder of the back may fall away not more than 1½-inches. The front face shall be at right angles to the planes of the top and ends and shall be sawed or tooled to an approximately true plane with no projections or depressions greater than 1/4-inch measured from the vertical plane of the face through the arris or pitch line.

The ends of all stones shall be cut square with the planes of the top and face. Ends of stones at joints where they are to be in contact with preformed joint filler must be held full for their entire depth and finished by sawing or tooling with a maximum variation of 1/4-inch. Ends of stones at intermediate joints shall be held full for 2 inches from all exposed surfaces with a permitted variation of 1/4-inch. Beyond this area the joint may fall away a maximum of 3 inches.

M.09.05.5 Special Sloped Face Granite Curb for Bridge Railings. The top surface shall be sawn, or dressed, equivalent to an approximately true plane with no projections or depressions greater than 1/4-inch. The bottom surface shall be sawn, or dressed, to an approximately true plane with not more than a dimensional tolerance in curb rise of +0 to -1/2-inch. The front arris lines at the top and bottom of the slope shall be straight and true with no variation greater than 1/8-inch. The sloped surface and the front vertical surface shall be sawn, or dressed to a + 1/4-inch tolerance. The back of the curb shall be either scabbled, or quarry split and shall not fall away from the vertical more than 3 inches toward the front or have any projections exceeding ½-inch.

The ends of all stones shall be cut square with the planes of the top and face. Ends of stones at joints where they are to be in contact with preformed joint filler must be held full for their entire depth and finished by sawing or tooling with a maximum variation of 1/4-inch. Ends of stones at intermediate joints shall be held full for 2 inches from all exposed surfaces with a permitted variation of 1/4-inch. Beyond this area the joint may fall away a maximum of 3 inches.

M.09.05.6 Anchors. Anchors shall be No. 6 Reinforcing Bars to the dimensions shown on the Plans. At least 3 anchors shall be furnished and installed in each stone.

M.09.05.7 Mortar. Mortar for joints shall be composed of 1 part Portland cement to 2 parts clean sand with sufficient water to form a workable mixture. Mortar shall be used within 45 minutes after its preparation.

SECTION M.10

DUST CONTROL, RIPRAP, STONE WALLS, COBBLESTONES, FLAGSTONES, HIGHWAY BOUNDS

M.10.01 (OPEN)

M.10.02 CALCIUM CHLORIDE. Calcium chloride shall conform to the requirements of AASHTO M144.

M.10.03 RIPRAP. Riprap shall consist of broken stone produced from sound ledge or large boulders with at least three fractured faces on each particle and shall be free from overburden, spoil, shale or organic material. The stone shall have a minimum density of 160 pounds per cubic foot. It shall be angular in shape with its minimum dimension not less than one third of the maximum dimension. Stone for Placed Riprap shall have one flat face and shall be roughly square or rectangular to facilitate laying up.

M.10.03.1 Bedding for Riprap. Bedding Stone as shown on the Plans shall conform to the quality requirements of this **Subsection M.10.03**, and shall conform to one of the following designations:

Filter Stone [1]

National Stone Association Modified NSA No.	Size Inches (square openings)		
	100% Passing	**0-50% Passing**	**0-15% Passing**
FS-1	½	No. 16	No. 50
FS-2	2	No. 4	No. 16
FS-3	6½	2.5	No. 4

Note 1: REFERENCE: National Stone Association manual; "Quarried Stone for Erosion and Sediment Control," dated 1978.

M.10.03.2 Stone for Riprap. Stone for riprap as shown on the Plans shall meet the quality requirements of this **Subsection M.10.03** and shall conform to one of the following designations. In addition, such stone shall be well graded within the size specified.

Graded Riprap Stone[1]

National Stone Association Modified NSA No.	Size Inches (square openings)		
	100% Passing	0-50% Passing	0-15% Passing
R-1	2	1	No. 4
R-2	4	2	1
R-3	8	4	2
R-4	14	7	4
R-5	20	10	6
R-6	26	13	8
R-7	34	18	14
R-8	50	24	18

Note 1: REFERENCE: National Stone Association manual; "Quarried Stone for Erosion and Sediment Control," dated 1978.

M.10.04 STONE WALLS. Stones for this work shall be natural field stone of a quality suitable to the Engineer and shall be roughly rectangular in shape with at least one fairly even face.

M.10.05 COBBLESTONES. Stones shall be hard durable cobbles not less than 4 inches nor more than 8 inches long by 6 inches wide and shall have a uniform thickness of not less than 4 inches.

M.10.06 FLAGSTONES. Flagstone shall be clean, even grain stone, finished with a rock face top and chisel edges. The face edge of tread shall not vary more than 1/4-inch from a line throughout its length.

Stone for use in walks shall have a uniform thickness of not less than 3 inches.

Stone for use as treads shall have a uniform thickness of not less than 1½-inches.

M.10.07 HIGHWAY BOUNDS.

M.10.07.1 Granite Bounds. Granite bounds shall be of the dimensions shown on the Plans and shall conform to the requirements of **Subsection M.09.01; Granite Curb for Roadways**, of these Specifications.

M.10.07.2 Reinforced Concrete Bounds. Materials for reinforced concrete bounds shall conform to the applicable requirements of **SECTION 601; PORTLAND CEMENT CONCRETE**, and

Subsection M.05.01; Bar Reinforcement, of these Specifications.

M.10.07.3 Bronze Rods. Bronze for highway markers shall conform to the requirements of AASHTO M107.

SECTION M.11

TIMBER

M.11.01 SAWN LUMBER. All timber used for construction shall be sawn lumber that meets both the classification and grading requirements for stress graded structural species and the following special requirements.

M.11.01.1 Structural Grades shall conform to ASTM D245; "Practice for Establishing Structural Grades and Related Allowable Properties for Visually Graded Lumber."

M.11.01.2 Mechanical Properties shall conform to ASTM D2555; "Method for Establishing Clear Wood Strength Values."

M.11.01.3 Allowable Stresses for sawn structural lumber shall be as designated by the Contract design criteria as noted on the Plans or in the Special Provisions.

M.11.01.4 Structural Lumber shall be American Standard Lumber manufactured and graded in accordance with the latest edition of the ALS PS 20. All such lumber shall be grade-marked in accordance with both the requirements of that standard and the applicable grading rules agency.

M.11.01.5 Sawn Lumber and Timber shall conform to AASHTO M168; "Standard Specification for Wood Products."

M.11.02 STRUCTURAL GLUED LAMINATED TIMBER. Structural glued laminated timber shall conform to the American National Standard Institute's publication ANSI/AITC A190.1; "Wood Products - Structural Glued Laminated Timber."

M.11.02.1 Working Stresses shall be determined according to ASTM D3737; "Test Method for Establishing Stresses for Structural Glued Laminated Timber."

M.11.02.2 Allowable Stresses shall be as designated by the Contract design criteria as noted on the Plans or in the Special Provisions.

M.11.02.3 Other Requirements of Subsection M.11.01; Sawn Lumber, of these Specifications shall also apply.

M.11.03 PRESERVATIVE TREATMENT. The preparation, process, amount, and type of preservative treatments shall conform to the requirements of Section 17; Division II of the AASHTO Standard Specifications for Highway Bridges. These requirements shall apply to both the wood preservatives and the preservative treatments of dimensional lumber, timber, posts, beams, stringer, and laminated members indicated on the Plans or in the Special Provisions.

The preservative treatment of structural timber and lumber shall be provided by the pressure process and, unless otherwise provided by the Special Provisions, shall conform to the requirements of AASHTO M133; "Standard Specification for Preservatives and Pressure Treatment Process for Timber"; the standards of the American Wood Preservers Association, and ASTM D1760; "Pressure Treatment of Timber Products."

The preservative retention requirements and treatment process shall be as designated on the Plans or in the Special Provision.

SECTION M.12

WATERPROOFING, DAMPPROOFING AND SEALERS (CONCRETE PROTECTIVE SYSTEMS)

M.12.01 DAMPPROOFING.

M.12.01.1 Primer shall be a cut-back solvent type conforming to ASTM D41.

M.12.01.2 Mop Coats shall conform to ASTM D449.

M.12.02 WATERPROOFING.

M.12.02.1 Hot Applied Liquid Membrane.

a. Surface Conditioner shall be a cut-back solvent type conforming to ASTM D41.

b. Waterproof Membrane shall be a single component, hot-applied, rubberized asphalt capable of being applied at a uniform thickness at an application temperature of 375°F - 425°F. 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)
Water Vapor Transmission	ASTM E96 Vapor trans-mitted in 24 hrs. gr/hr sq. ft. (g/hr sq. m)	At 77°F (25°C) 0.010 gr.(0.07 g) At 120°F (49°C) 0.016 gr. (0.11 g)
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

Test	Method	Required Results
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. (0.189 g) Max gain 2.513 gr. (0.359 g)
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 20 in/min (50.8 cm/min)	Min. toughness of 25 in./lbs. (29 cm/kg)
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 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 rolled asphalt sheets conforming to ASTM D224, Type II, except provisions pertaining to the roofing application are waived. 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.

a. Primer shall either conform to ASTM D41 or be as specified by the membrane manufacturer.

b. Sheet Membrane shall conform to the following specifications.

Test	Method	Required Results
Thickness	-	60 mils (± 5 mils)
Tensile Strength	Per ASTM D882	50 lbs./in. (88 N/cm) 25% elongation, min
Pliability	Per ASTM D146 At -15°F (-26°C) with 1" (25.4 mm) mandrel	No cracks or splits
Puncture Resistance	ASTM E154	200 lbs. (890 N) min.
Permeance	ASTM E96	0.1 perms (.066 m perms), max.

M.12.02.3 Cold Applied Liquid Membrane. This membrane shall be used when any one of the following conditions apply: grade greater than five percent, high braking areas (i.e., intersections), super elevated decks (greater than 1/4 in./ft.), low radius curves (less than or equal to 1000 feet), or history of asphalt shoving.

a. Primer shall be a 100-percent solvent-free reactive, acrylic-based, two-component resin.

b. Membrane shall consist of an acrylic resin based two coat, 100-percent solvent-free reactive, two-component elastomeric membrane. Each coat shall be 60 mils (1.5 mm) thick and differentially pigmented for quality control. In addition the membrane shall meet or exceed the following properties, backed by a certificate of conformity, as related to laboratory prepared samples tested at 68°F (20°C) and a 24-hour cure, where applicable.

Test	Method	Required Results
Cure Time	N/A	30 Minutes
Water Vapor Transmission	ASTM E96	0.026 gr./ft^2/hr (0.18 g/m^2/hr
Adhesion to Concrete	ASTM D4541	100 psi (0.7 MPa)
Adhesion to Steel	ASTM D4541	290 psi (2.0 MPa)

Test	Method	Required Results
Tensile Strength	ASTM D638, Method A, Die C	435 psi (3.0 MPa)
Min. Elongation at break	ASTM D638, Method A, Die C	100%
Low Temperature	1/4" (6.35 mm) mandrel @-13ºF (-25ºC)	Pass
Crack Bridging	ASTM C836	Pass @ 25 cycles, 0.0625 in, -15ºF (1.6 mm, -26ºC)

M.12.03 CONCRETE PROTECTIVE SEALERS. All material is subject to the approval of the Engineer, shall have been tested and approved by the Department 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, or as recommended by the manufacturer.

g. Shall be used as supplied 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 Department 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.

SECTION M.13

BRIDGE BEARINGS

M.13.01 ELASTOMERIC BEARINGS.

M.13.01.1 Elastomer. The raw elastomer shall be virgin neoprene (polychloroprene). The elastomer compound shall be classified as being of low temperature grade 0, 2, 3, 4, or 5 as defined by the testing requirements in Table 18.2.3.1A in Section 18 of the AASHTO Standard Specifications for Highway Bridges (Fifteenth Edition).

M.13.01.2 Steel Laminates. Steel laminates used for reinforcement shall be fabricated from rolled mild steel conforming to the requirements of ASTM A36 or A570 unless otherwise specified by the Engineer. The steel laminates shall have a minimum nominal thickness of 16 gauges. Holes in plates for manufacturing purposes will not be permitted unless they have been accounted for in design, and indicated as such on the Plans.

M.13.01.3 Fabric Reinforcement. Fabric reinforcement shall be woven from 100 percent glass fibers of "E" type yarn with continuous fibers. The minimum thread count in either direction shall be 25 threads per inch. The fabric shall have either a crowfoot or an 8 Hardness Satin weave. Each ply of fabric shall have a minimum breaking strength of 800 lb./in. of width in each thread direction. Holes in the fabric will not be permitted.

M.13.01.4 Bond. The vulcanized bond between fabric and reinforcement shall have a minimum peel strength of 30 lb./in. Steel laminated bearings shall develop a minimum peel strength of 40 lb./in. Peel strength tests shall be performed by ASTM D429 Method B.

M.13.02 POT AND DISC BEARINGS. All materials used in the manufacture of pot and disc bearings shall be new and unused. No reclaimed materials shall be incorporated in the finished bearings. All pot and disc bearings required for the Contract shall be fabricated by a single manufacturer.

Materials, including the elastomeric rotational element, sealant, sealing rings, steel, stainless steel, and TFE sheet shall conform to the requirements of Subsection 18.3.3 of the AASHTO Standard Specifications for Highway Bridges (Fifteenth Edition).

M.13.03 SLIDING BEARINGS.

M.13.03.1 Carbon Steel. Sole, pivot and masonry plates shall conform to the requirements of AASHTO M270, Grade 36.

M.13.03.2 Stainless Steel. Stainless steel shall conform to the requirements of ASTM A240, Type 304 or ASTM A167, Type 304.

M.13.03.3 Polytetrafluoroethylene (TFE). TFE resin shall be virgin material (not reprocessed) conforming to the requirements of ASTM D1457. Specific gravity shall be between 2.13 and 2.19. The melting point shall be $623^{O}F \pm 2^{O}$.

M.13.03.4 Bedding of Masonry Plates.

a. Preformed Fabric Pads used as bedding shall be composed of multiple layers of 8-ounce cotton duck impregnated and bonded with high quality natural rubber or of equivalent and equally suitable materials compressed into resilient pads of uniform thickness. The number of plies shall be such as to produce the specified thickness, after compression and vulcanizing. The finished pads shall withstand compression loads perpendicular to the plane of the laminations of not less than 10,000 pounds per square inch without detrimental reduction in thickness or extrusion.

b. Sheet Lead used as bedding shall be common desilverized lead conforming to ASTM B29. The sheets shall be of uniform thickness and shall be free from cracks, seams, slivers, scale, and other defects. Unless otherwise specified, lead sheets shall be 1/8-inch in thickness with a permissible tolerance of 0.03-inch plus or minus.

M.13.03.5 Anchor bolts, including nuts and washers, shall be galvanized and shall conform to the applicable requirements of **Subsection M.05.04.4** of these Specifications.

SECTION M.14

STONE FOR MASONRY

M.14.01 STONES. The stone shall be of a kind specified on the Plans. The stone shall be of approved quality, sound and durable, resistant to weathering action, reasonably uniform in color unless otherwise specified, free from seams, cracks, laminations and minerals which by weathering would cause discoloration or deterioration. Stone, unless otherwise specified, shall be from a quarry the product of which is known to be of satisfactory quality. Stone shall be properly seasoned and of such character that it can be wrought to such lines and surfaces, whether curved or plane as may be required. The stone shall be kept free from dirt, oil and any other injurious material which may prevent the proper adhesion of the mortar and concrete backing, or detract from the appearance of the exposed surfaces. Samples of the stone to be used shall be submitted when

requested by the Engineer. When seam faced stones or a variety of distributed sizes, colors and textures is desired, the stone shall be obtained from more than one source if necessary.

All granite shall conform to ASTM C615.

M.14.01.1 Sizes and Dimensions.

a. Cut Stone (dressed or tooled). All dimensions shall conform to those shown on the Plans, unless changes are ordered in writing by the Engineer. Where the width of bed is not shown, it shall be not less than 1¼ times the rise with a minimum width of 10 inches. The length of headers shall be not less than the width of the bed of the widest adjacent stone plus 12 inches. Stretchers shall have a length of not less than 2½ times their thickness, nor less than 3 feet, and not more than 3½ times their thickness. The Contractor shall, before any stone is delivered, prepare course layout plans with sufficient detail of individual stones to permit cutting in the quarry.

Stone shall be cut to lie on the natural beds with tops and bottoms parallel, except where otherwise shown. The contact area of the beds shall be free from large depressions and cuppings which might impair the stability of the work and shall be dressed for at least 4 inches back of the pitch line. The vertical joints shall be dressed at right angles to the face for at least 2 inches back from the face, at which point they may fall away not more than 1 inch. The beds and joints for caps, copings and special units shall be dressed a corresponding distance from all exposed faces.

b. Split-face. The dimensions and proportions of stone shall be substantially as shown on the Plans, but may be varied as directed by the Engineer to produce the desired effect. Unless otherwise specified, stone facing may vary from 9 to 15 inches in thickness, with occasional deeper stones for header purposes. Square units shall be avoided as far as possible. Stone for capping shall conform to section dimensions and reasonably conform to the lengths shown by scale on the drawings.

c. Rubble. The stones to be used for this type of masonry shall consist of irregular quarry stones without other preparation than the removal of very acute angles and excessive projections from the general surface. Stone removed from existing structures within project limits, or stones from other approved sources may be used. No stone less than 9 inches in thickness shall be used, unless otherwise specified.

M.14.01.2 Surface Finish.

a. Cut Stone (dressed or tooled). For the purpose of this Specification the surface finishes of cut stone are defined as follows:

Smooth-finished: Having a surface in which the variations from the pitch line do not exceed 1/16-inch.

Fine-finished: Having a surface in which the variations from the pitch line do not exceed 1/4-inch.

Rough-finished: Having a surface in which the variations from the pitch line do not exceed ½-inch.

Scabbled: Having a surface in which the variations from the pitch line do not exceed 3/4-inch.

Rock-faced: Having an irregular projecting face without indications of tool marks. The projections beyond the pitch line shall not exceed 3 inches and no part of the face shall recede back of the pitch line.

b. Split-face. Stone in exposed surfaces shall be split-faced unless otherwise specified, and the maximum projection shall be 1 inch at the base of walls and shall taper off to about ½-inch adjacent to concrete copings or caps. Concave faces shall be avoided, and the top surface of capping shall be slightly crowned to shed water.

c. Rubble. Stones shall be selected and laid so as to present faces that will reasonably conform to the general plane of the wall surface, avoiding conspicuous projections extending over 2 inches from the face line, or depressions more than 1 inch deep.

SECTION M.15

TRAFFIC CONTROL SYSTEMS

M.15.01 GROUND RODS. Ground rods shall be a 5/8-inch diameter by 10-foot long rod of copper-clad steel and shall be equipped with a copper-clad clamp of sufficient size to receive the ground wire.

M.15.02 WIRE AND CABLE.

M.15.02.1 Wire for Highway Lighting.

a. General. Wire and cables shall be single conductor except where otherwise specified or indicated on the Plans. Conductors of sizes No. 10 AWG and larger shall be stranded. Wires of sizes smaller than 10 AWG shall be solid.

The conductors shall be factory identified by printing the size and type of insulation. Each conductor shall be colored in accordance with the National Electric Code. Insulation color shall be constant throughout the length of the conductor and shall not otherwise need to be taped or tagged for identification. The color of the insulation of the neutral conductor shall be white. The remaining conductors shall not be white but shall be of dissimilar colors for identification.

b. Conductors. Wire conductors shall be annealed copper conforming to the following specifications as applicable.

American Society for Testing Materials

ASTM B3 - specification for annealed copper wire.

ASTM B8 - specification for concentric-lay-standard, copper conductor, hard, medium hard or soft.

ASTM B33 - specification for tinned soft or annealed copper wire for electrical purposes.

c. Insulation. Insulation shall be indicated and shall conform to the following specifications as applicable.

American Society for Testing Materials

ASTM D1351 - (THW and THWN) specification for polyethylene insulated wire and cable

ASTM D2655 - (XHHW-2) specification for crosslink, thermosetting polyethylene insulation for wire and cable 0 to 600 volts.

All wire below finish grade shall be XHHW-2. THW or THWN may be used between the handhole and fixture if the percent of wire above ground is greater than the percent below ground.

d. Cable Jacket. Insulation shall be jacketed and have an outer covering as specified in the National Electric Code, Table 310-13, "Conductor Applications and Insulations." When specified by the National Electric Code, the neoprene jacket shall conform to ASTM D752.

e. Insulation and Jacket Thickness. The minimum thickness of insulation and jacket thickness shall be as follows:

Conductor Size	Insulation Thickness in 64ths	Jacket Thickness in Inches
14 thru 10 AWG	3	.015
8 thru 2 AWG	4	.030
1 thru 4/0 AWG	5	.045
250 thru 500 MCM	6	.065
600 thru 1000 MCM	7	.065

M.15.02.2 Ground Wire. Ground wire shall be seven strand, No. 6 AWG, soft drawn copper and shall conform to the requirements of **Para. b** of **Subsection M.15.02.1**.

M.15.02.3 Service Conductors. Service conductors shall be No. 6 AWG, National Electrical Code Type "THHN" or "TWH" and shall meet the requirements of **Paras. a** through **e** of **Subsection M.15.02.1**.

M.15.02.4 Traffic Signal Cable. Traffic signal cable or wire shall conform to IMSA Specification 19-1 or 20-1.

M.15.02.5 Loop Detector Wire. Wire for inductance loop detectors shall consist of No. 14 AWG, meeting the requirements of IMSA Specification 51-5.

A roadway loop embedding sealer approved by the Engineer shall be used to encapsulate traffic signal loop wires embedded in highway materials. The sealer shall be cold applied and may be a one- or two-component system, the viscosity of which shall be sufficient to allow the material to be either poured or placed under pressure and fully encapsulate the loop wires. The sealer shall be curable at temperatures of 40°F and above, and, when bonded to common paving materials, it shall have sufficient strength and resiliency to withstand stresses due to vibrations and differences in expansion and contraction as a result of temperature changes or traffic conditions. The sealer shall be compatible with the sheathing and covering of loop inductance wire, and shall be resistant to most chemicals and solvents, including salts, acids, hydrocarbons, etc.

M.15.02.6 Loop Detector Lead-In Cable. Loop Detector Lead-In Cable shall meet the requirements of IMSA Specification 50-2.

M.15.02.7 In-Line Disconnect Device. Each unfused disconnecting device shall consist of a copper pin and a copper receptacle of at least 90 percent conductivity to be crimped to the cable. The receptacle shall establish contact pressure with the pin through the use of a copper beryllium sleeve spring and shall be equipped with a disposable mounting pin. The receptacle shall be fully annealed. Both the copper pin and receptacle shall have a centrally located recessed locking area adaptor to be complimentarily filled and retained by the rubber housing. The fused disconnecting device shall consist of a spring loaded 90 percent minimum conductivity contact suitable for gripping the specified cartridge fuse. These contacts shall be fully annealed and adapted to be crimped to the cable and shall be adapted to be retained securely in the proper position within the rubber housing. The disconnect device housing shall consist of water resisting synthetic rubber capable of being buried in the ground. Each housing shall provide a section to form a water seal around the cable, have an interior pin or fuse contacts, and a section to provide a water seal between the two housings at the point of disconnection. Each housing shall be permanently marked "load side" or "line side." Fuse for the disconnecting devices shall be rated 600 volts, 100,000 ampere interrupting capacity, and shall be 13/32-inch diameter, 1½-inches long, with a melamine glass-fiber tube and sand filler surrounding the links.

M.15.02.8 Two-Way Splice.

a. Copper Compression Lugs and Connectors. Lugs and connectors shall be copper compressed with industry tooling. The lugs and connectors must have a current carrying capacity equal to the conductors for which they are rated and must also meet the requirement as listed in UL 486.

b. Heat Shrinkable Tubing. This material shall be suitable for URD, submersible or direct buried installation. The tubing shall be UL approved and suitable for application on systems up to 600 volts, 90°C rating, and shall be precoated with thermoplastic adhesive sealant. When heated, the internal coating shall melt and seal the connection from moisture and dirt and adhere to the insulation material on the cable.

M.15.02.9 Semi-Permanent 3-Way Splice Kits. Splice material shall consist of compressed feeder lugs and compressed tap lug enclosed in a feeder housing and shall be "Y" type with electrical rating of 600V, 150 AMP, copper.

All housings shall be made of water resistant synthetic rubber suitable for burial in ground or exposure to sunlight. Each housing shall form a watertight seal around the cable and between the insert body and enveloping Y housing.

M.15.03 HANDHOLES AND PULL BOXES.

M.15.03.1 Precast Handholes and Pull Boxes. Precast Type A Handholes, Precast Type H Heavy Duty Handholes, and Precast Type B Pull Boxes shall be designed and manufactured in accordance with ASTM C478; "Precast Concrete Manhole Sections," with the additional stipulation that the concrete mix design shall be Class XX (AE) as set forth in **SECTION 601** of these Specifications.

Cast iron frames and covers shall conform to the relevant provision of **Subsection M.04.03.6**, or as indicated on the drawings. Covers on traffic signal handholes shall have the word "Signal" cast into them. Covers on telephone handholes shall have the word "Comm" cast into them. Covers for electric pull boxes shall have the word "Electric" cast into them.

Steel reinforcing shall conform to the relevant requirements of **Subsection M.05.01** of these Specifications.

Support grips shall be provided for each cable, including ground wire, in each handhole or pull box and shall be of the closed mesh type for permanent support with cable end made of stainless steel with capability of supporting 600 pounds complete with supporting hook.

M.15.03.2 Metal Pull Boxes. Pull boxes shall be galvanized steel, thickness as indicated on the Plans. Boxes shall be furnished complete with tapped hubs, galvanized checkered plate covers as indicated and neoprene gaskets. The cover shall be fastened to the frame with a minimum of four, 3/8-inch diameter flat head brass screws set flush with the cover. Boxes shall be provided with mounting lugs.

Pull boxes shall be listed by Underwriters Laboratories and shall be tested for submersible application.

Tapped holes shall be provided for conduit entrances. Drainage including a 1-inch plastic drain pipe shall be provided as indicated on the Plans.

M.15.04 CONDUIT AND FITTINGS.

M.15.04.1 Rigid Steel Conduit and Fittings. This conduit shall conform to Federal Specification WW-C-581. The latest revision of the Underwriters' Laboratories, Inc. Publication UL-6-Standard for Rigid Metallic Conduit also forms a part of this Specification. In addition to the above requirements, the exterior surface conduit including fittings shall be zinc-coated and the interior coated with zinc, enamel, or other corrosion resisting coating. The conduit shall be metalized galvanized, hot-dip galvanized or electro-galvanized.

Threads and couplings shall conform to the provisions of Appendix III of ASTM A53; "Basic Threading Data for Pipe."

M.15.04.2 PVC Plastic Conduit. Plastic conduit and plastic fittings shall conform to the requirements of Federal Specification W-C-1094 (GSA-FSS); Conduit and Conduit Fittings, Plastic, Rigid, and the latest amendments.

M.15.04.3 Expansion Couplings. The fittings shall be designed to compensate for expansion in a horizontal line of conduit at expansion joints in a structure and shall be as detailed.

Expansion fittings shall provide for a maximum of 4 inches longitudinal conduit movement, 2 inches in either direction. Expansion fittings shall provide for transverse conduit movement as indicated where required by structural conditions.

Expansion fittings shall be bonded with heavy duty, two bolt, ground fittings. Strap type clamps will not be acceptable.

M.15.05 LUMINAIRES.

M.15.05.1 Luminaires with Integral Ballast and Photo Cell. Luminaires shall be multiple high pressure sodium type with 2-inch slip fitters. Each luminaire shall be constructed of a two-piece aluminum die-cast housing. Latching assembly shall be a double action snap safety type. The hinge pin and hinge plate shall be of stainless steel with complete sealed and tilted optical system. The projected surface area of each luminaire shall not exceed 2.25 square feet, excluding the photo electric control (when called for).

The slip fitter shall be of an adjustable type accommodating 1¼-inch to 2-inch diameter pipe with four stud mounting bolts with two "U" brackets locking a full 7½-inch desirable, 5½-inch minimum of bracket to sustain a 90 mph wind load.

The optical assembly shall include a specular Alzak aluminum reflector removable without tools. A refractor of prismatic heat resisting borosilicate glass shall be factory installed. The lamp holder shall be of high grade porcelain, enclosed type with both axial and vertical adjustment with visible marking.

The optical system shall be gasketed with heat resistant, non-moisture absorbing chemical treated polyester felt to provide a filtering action to filter out dirt and other foreign matter.

The luminaires shall be of the horizontal type for IES Type III medium full-cut off lateral light distribution or as otherwise indicated on the Plans. The IES distribution shall be accomplished by the use of nominal 27,500 (for 250-watt system) or 50,000 (for 400-watt system) initial lumen, 24,750 (for 250-watt system) or 45,000 (for 400-watt system) mean, 250-watt or 400-watt high pressure sodium lamp, 24,000 rated hour. Lamps shall have a rating of not less than 90 percent power factor through the entire life of lamp. The installation date shall be marked with an indelible marker on each lamp. This marking shall not alter the light distribution. Luminaires shall be provided complete with lamps.

Luminaires shall be provided with twist lock receptacles for individual photo-electric control. Provisions shall be made to orient the receptacles to the north. Receptacles shall be molded hard rubber, and shall be installed with neoprene gasket and retaining ring.

M.15.05.2 Ballast. Ballasts shall be integral with the luminaire and shall be regulated to operate at not less than 90 percent power factor, have not more than 300 watts (for a 250-watt system) or 465 watts (for a 400-watt system) input, and shall be suitable for operation at minus 20°F. Ballasts shall be multi-type, tap suitable for the operating range of the required voltage, plus or minus 10 percent, and shall hold the lamp-watts constant within plus or minus 5 percent.

M.15.05.3 Photo-Electric Controls. The controls shall be tubeless type suitable for 240-volt operation with the multiple high pressure sodium luminaires specified above. The photo-electric controls shall be rated 105-285 volts, 50/60 cycles, alternating current, 1,800 volt-amperes, for high pressure sodium loads with peak currents not greater than 120 amperes, and shall be rated with an inrush current rating of 60 amperes complete with single-pole, double-throw 1,000 watt relay. Controls shall have an adjustable turn-on at 1.0 - 2.5 foot-candles. The turn-off value shall be 10 foot-candles maximum. The operating level shall be from 0.5- 10 foot-candles.

The temperature operating range shall be from minus 50°F to plus 150°F.

Each photo-electric control shall consist of a dependable, simple, tubeless circuit, including a hermetically sealed, broad area cadmium sulfide photo-cell capable of controlling a relay without intermediate amplification. The relay shall be de-energized during the night with normally closed contacts in the closed position and the luminaire energized. During the day the relay shall be energized with contacts open and the luminaire de-energized. Fail-safe features shall provide for the lighting load to remain turned on in the event of failure of the electric circuit. Directional design features and a time delay shall be incorporated in the photo-electric controls to prevent false turn-offs to headlights and other transient light sources.

The individual components of each photo-electric control shall be mounted on a bakelite chassis and protected by a weatherproof acrylic housing. The photo-electric controls shall mount directly on the high pressure sodium luminaires and shall conform to EEI-NEMA standards for locking, sealing and base dimensions.

M.15.05.4 Protective Screen for Understructure Luminaire. Angle iron shall be 1½" x 1¼" x 2.34 pounds per foot. Angles shall be galvanized after welding corners and drilling. Wire mesh shall be galvanized chain link type, #6 gauge, with approximately 1-inch square openings.

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 1.3 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 luminaire structures on interstate 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 luminaire 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 tapes 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 tampered 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 be capable of withstanding a load of 18,500 foot-pounds. 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 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.

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 apparent permanent deformation after the load has been removed.

M.15.06.2 Light Standard Foundation.

a. Concrete. Light standard foundations may be cast in place or precast units. Cast-in-place units shall be constructed of Class A(AE) cement concrete masonry. Precast units shall be constructed of Class XX(AE) cement concrete masonry.

Cement concrete masonry shall conform to the applicable provisions of **SECTION 601** of these Specifications.

b. Steel Reinforcement. Steel reinforcement shall conform to the requirements of **Subsection M.05.01.**

c. Anchor Bolts. Anchor bolts shall be high strength steel having a minimum yield of 55,000 psi. They shall be 1 inch in diameter by 66 inches long, with a 4-inch L bend on the unthreaded end. Each anchor bolt shall have cut or rolled thread 6 inches long. These threads shall be one inch-8 National Coarse Class 2 fit. A hexagon nut and leveling washers shall be furnished with each bolt. The anchor bolt, washers and the hexagon nut shall be hot dipped galvanized conforming to ASTM A153.

Anchor bolts for roadway lighting are to be provided and set according to templates furnished by the manufacturer.

Anchor bolts for bridge lighting are to be furnished as detailed on structural drawings.

d. Steel Conduit. Steel conduit, elbows, and fittings shall conform to the provisions of **Subsection M.15.04** of this Section.

e. Breakaway Support Couplings. The breakaway support couplings shall be the same as those manufactured by Transpo-Industries, Inc., of New Rochelle, New York, Precision Form of Gettysburg, PA, Manitoba Safe-T-Base of Winnipeg, Canada, or an approved equal.

M.15.07 SERVICE PEDESTAL. Service shall be at 120/240 or 240/480 volt, single phase and 277/480 volt, three phase, four wire.

M.15.07.1 Enclosure. Exterior mounted, weatherproof, NEMA 1, Type 304 stainless steel service enclosure with body stiffeners and mounting shall be provided on a concrete pad and shall conform to the general arrangement and dimensions indicated. The enclosure walls and top shall be cast solid with one opening on the north wall. This opening shall be covered with a lexan, watertight window approximately 5½-inches by 9 inches long. A 10-gauge steel back panel with white baked enamel finish shall be provided for mounting the panelboard, photo control, relay and contactor. The back panel shall be drilled and tapped as required to mount equipment. The enclosure shall be provided with stainless steel, hinged bolted gasketed doors, combination flush access handles, hasp and brass padlock, directory frame and two sets of keys. The enclosure shall be anchored to the concrete base using four 3/4-inch anchor bolts embedded at least 14 inches into the concrete. The service pedestal shall be provided with a 1/4-inch thick by 2-inch wide neoprene gasket continuous around the perimeter of the enclosure base. Joints or splices in gasket shall be vulcanized in an approved manner. The entire installation shall be watertight.

The enclosure shall include space for all materials listed.

The enclosure shall have a watertight air vent in the roof, a 20 amp GFI receptacle, a keyless light with 15-amp single pole switch, and a 500-watt pumphouse heater with controlling thermostat mounted inside at the base.

M.15.07.2 Panelboard. A split panelboard shall be supplied with the enclosure in accordance with the schedule indicated on the drawing. The panelboard shall be equipped with a main breaker of the size indicated on the Plans and shall be designed for single-phase, 3-wire, 120/240 or 240/480 volts (as specified on the Plans) alternating current and shall be suitable for mounting within the service enclosure. The panelboard shall be of the dead front safety type with the capacities of breakers as indicated on the Plans.

The circuit breaker mechanisms shall be quick-make, quick-break on manual as well as automatic and shall be trip-free from the handle so that the contacts cannot be held closed against circuit faults or abnormal overloads. The main circuit breaker shall be two-pole rated at 600 volts. The frame size shall be 225 Amp, 200 ampere trip setting or as otherwise indicated on the Plans, and shall have an interrupting rating of 22,000 amperes at rated voltage. The one-pole branch breakers shall be rated at 277 volts, and two-pole branch breakers shall be rated at 600 volts. Frame size and trip setting shall be as indicated on the Plans and have interrupting ratings of 15,000 amperes symmetrical. The mounting panel on which circuit breakers, busses and bolts for making copper connections shall be equipped with lock washers to prevent loosening. Riveter bus connections will not be acceptable. The busses shall be securely fastened to insulating bases and shall have copper based on 1,000 amperes per square inch copper density. Busses shall be drilled and tapped to permit future circuit changes without the necessity for additional machining. Panelboards shall be designed and assembled so any individual breaker may be removed without disturbing adjacent breakers or necessitating the removal or loosening of required insulation. All terminal lugs shall be copper, bronze or brass.

M.15.07.3 Service Pedestal Concrete Mat. The service cabinet concrete mat shall be constructed of Class A(AE) concrete in accordance with **SECTION 601; PORTLAND CEMENT CONCRETE**, of these Specifications.

M.15.07.4 Photo-Electric Control. Photo-electric controls shall conform to the requirements of **Subsection M.15.05.3** of this Section, and shall mount inside the service pedestal or as indicated on the Plans.

M.15.07.5 Contactors. Contactors shall be rated for H.I.D. lighting inductive loads, 600 volts, 2-pole, continuous duty ampere as indicated and shall be mechanically held. Contacts shall be silver tungsten. A separate 120- volt circuit shall be provided for coil operation with a hand-off automatic selector switch.

M.15.07.6 Poles. Poles for temporary work shall conform to U.S.A.S.I. Class 5. Poles shall be southern yellow pine treated in accordance with **Subsection M.11.03; Preservative Treatment**, of these Specifications.

M.15.08 SERVICE UNITS.

a. Disconnect Switch. Disconnect switch shall be of the fusible type, heavy duty, 250 Volt A.C., NEMA 3R rain-tight and shall conform to Federal Specification W-S-865.

b. Fuses. Fuses shall be dual-element and shall be capable of carrying 500 percent of the indicated rating for a minimum of 10 seconds, shall have an interrupting rating of 100,000 RMS amperes and shall have standard National Electrical Code dimensions.

M.05.09 METER SOCKETS. Meter sockets shall be provided at all service pedestals, traffic signal controllers, intersection control beacons and counter stations. Meter sockets for all of the above applications shall be 5-terminal duncan type and meet all requirements of the local utility company. Meter sockets for traffic signal controllers and service pedestals shall include a manual by-pass.

The line side of the service conductors shall be encased in a watertight PVC conduit within the service enclosure or signal cabinet.

M.15.10 POLE LINE HARDWARE. All miscellaneous pole line hardware required to complete the project as planned shall be standard material manufactured for pole line construction. All metal parts shall be hot-dipped galvanized.

In addition to the above, whenever secondary racks are required they shall be as classified "Heavy Service Secondary Rack" by the EEI-NEMA, and shall have a minimum spacing of 12 inches between the insulators. Each rack shall be secured to the pole by not less than one through bolt and one lag bolt.

All pole hardware, bolts, plate rods, hangers, clips, wire guards and pole bands shall be hot-dipped galvanized in conformance with the requirements of ASTM A153.

M.15.11 METALS. Metals for light standards, poles, bases and hardware shall conform to the same specifications as set forth in **Subsection M.16.04.3** except that design stresses may conform with CE Paper 3341 for 6061-T6 aluminum as it may be modified by subsequent AASHTO publications.

M.15.12 MESSENGER CABLE, FITTINGS. Messenger cable shall be wire steel strand messenger cable conforming to ASTM A475, extra-high-strength grade, Class A galvanized, unless otherwise noted on the Plans.

M.15.13 TRAFFIC SIGNAL CONTROLLER UNITS AND CONTROLLER CABINETS.

M.15.13.1 16-Phase Controller Units.

a. General. Controller units shall be completely digital solid-state capable of a minimum of sixteen phases which, when connected to traffic detectors or other means of actuation or a combination thereof, shall operate the electrical traffic signal system at one or more intersections. The controller unit (CU) shall communicate with the malfunction management unit (MMU) via port 1.

The controller unit shall be a Type A1 configuration conforming to Section 3 of the latest edition of the NEMA Standards Publication TS-2, Traffic Controller Assemblies. The CU shall utilize

an input/output interface conforming to Subsection 3.3.1 of the NEMA TS-2 Standards for all input/output functions with the back panel terminals and facilities, the malfunction management unit, traffic detector rack(s) and auxiliary devices.

1. Controller Display. Controller units shall utilize liquid crystal displays and be internally illuminated for night viewing. The display shall consist of a minimum of four lines of text with a minimum of 40 characters per line. As a minimum, the model number and software version level shall be displayed.

2. Controller Security Codes. The controller unit shall provide for a user-specified code entry before allowing any data to be altered. All parameters may, however, be viewed without entering a valid security code. Security code access shall be terminated at a fixed time after access was gained or a keystroke was made. The CU may have the ability via keyboard to disable security code access allowing for constant access to parameter changes.

3. Battery Backup. Controller units shall come with a backup for the real-time clock only. The backup system shall be capable of maintaining the real-time clock for a period of 30 days. All program timings are to be maintained in Electronically Erasable Programmable Read-Only Memory (EEPROM).

b. Functional Requirements. Local intersection controller units shall meet the following functional requirements:

1. Programming shall be accomplished by front-panel menu-driven keyboard entry.

2. Controller units shall provide a user programmable daylight savings time capability.

3. Controller units shall provide data uploading and downloading capability to both a remote central computer station and a direct link to a laptop computer. A minimum 25-foot laptop communications cable configured for the supplied equipment shall be provided in the controller cabinet.

4. Controller units shall have the capability of performing dynamic self-diagnostic testing per NEMA TS-2 Standards, Section 3.9.

5. Controller units and all auxiliary devices shall meet all environmental requirements as set forth in NEMA TS-2 Standards, Section 3.9.

c. Additional Requirements.

1. Controller Coordination and Pre-emption. The controller unit shall be capable of both coordinated operation and pre-emption operation in accordance with the NEMA TS-2 Standards, Section 3.

Given split and cycle timings, the controller unit shall provide a means of automatically calculating coordination yield points, permissive periods and force-offs.

2. Phase Designations. The phase data in the controller unit shall match the numbering scheme shown on the Plans and operate in the same sequence as shown in the Phase Sequence

Diagram on the Plans. Changes to the phase numbering or phase sequence shown on the Plans must be approved by the Department's Traffic Design Unit before being implemented.

3. Programmable Field Hardware Documentation. Before the traffic signal is placed in operation, each programmable field hardware component shall be completely programmed by the Contractor to reflect timings or settings shown on the Plans. Programming is defined as user programmable keyboard entries or switch settings. Programmable field devices include, but are not limited to, controller units, closed loop system masters, malfunction management units, detector units, modems, radios, pre-emption devices, etc.

4. Controller Guarantee. The entire controller unit shall be warranted to be free from defects in workmanship and material for one year, or for the greater length of time common to trade practice, from the date of acceptance by the Engineer. Any defective parts are to be replaced free of charge. Manufacturers warranties shall become the property of the State at the time of acceptance.

M.15.13.2 Controller Cabinet.

a. General. Controller cabinets shall conform to Section 7 of the NEMA TS-2 Standards. The minimum size controller cabinet to be supplied shall be a size 6(P) cabinet, unless shown otherwise on the Plans. The cabinet finish shall be unpainted natural aluminum, degreased and free of scratches and blemishes. The traffic signal number shall be stenciled on the inside and outside of the cabinet door on State owned signals in 3-inch block letters.

b. Concrete Work Pad. In unpaved areas, a 48" x 30" x 4" concrete work pad shall be installed in front of the cabinet door. The pad shall be placed on 6 inches of gravel borrow subbase. The concrete shall be Class A concrete conforming to the requirements of **SECTION 601; PORTLAND CEMENT CONCRETE**, of these Specifications.

c. Shelves and Document Tray. Each cabinet shall be furnished with a minimum of two movable shelves suitable for placing the controller, MMU, detector racks, modems, radios or any other required equipment. A slide-out document tray shall be mounted below the bottom shelf. The tray shall be of sufficient size to hold cabinet wiring diagrams and two manuals. The tray shall operate by sliding out on nylon rollers or ball bearings and opening a hinged cover to remove documents. The closed cover shall provide a suitable support for resting documents or a laptop computer. All cables shall be tied away to allow the tray to be opened and closed smoothly without any obstructions.

d. Electrical Outlets. In addition to the requirements of the NEMA TS-2 Standards, Section 5.4.2.6, local controller cabinets shall be furnished with a GFI receptacle on the cabinet door and a duplex outlet within the body of the cabinet. Cabinets which are to contain a closed-loop system master controller, a local controller and auxiliary communications equipment (radios or modems) shall have two duplex outlets in addition to the door mounted GFI receptacle.

e. Interior Lighting. In addition to the requirements for an incandescent fixture in NEMA TS-2 Standards, Section 5.4.2.7, cabinets shall be provided with a "goose neck" lamp having a flexible arm and utilizing a 25 watt R14 bulb (115VAC). The lamp shall be mounted at a location on the side panel approximately level with the load switch/terminal panel for concentrated illumination of this area. The lamp shall have its own on/off switch on the unit.

f. Controller Cabinet Documentation. Two sets of complete cabinet schematics and operating manuals for the controller unit, loop detector units, closed loop system master, modem and any other programmable field hardware supplied shall be included as part of the cabinet documentation.

Three hard copy sets of all programmed data shall be supplied to the Department at the time the controller is installed in the field. Each set shall be bound and covered. One set is to remain in the cabinet, one set is to be delivered to Traffic Design, and one set is to be delivered to Traffic Maintenance.

g. Controller Cabinet Service Switches. All cabinet switches shall be clearly labeled to indicate the switch's function. Toggle switches shall indicate the state of each switch position.

1. Open Door Alarm. A pushbutton switch shall be installed on a bracket in the top right of the controller cabinet door. The output of the switch shall be connected to the alarm No. 1 input as defined by the NEMA TS-2 Standards, and record the opening of the cabinet door as a local alarm.

2. Police Door Switches. Police door switches shall have the following:

(a) An Auto/Manual switch that toggles between automatic operation and manual operation. During manual operation, an extendible hand-control pushbutton shall utilize Manual Control Enable and Interval Advance to control the intersection operation. The hand-control pushbutton shall be installed inside the police door. The hand control pushbutton shall be rugged in construction with a weatherproof covering over the cord's pushbutton switch.

The auto/manual switch shall be connected to alarm No. 2 as defined by the NEMA TS-2 Standards. When the switch is placed in the manual position, it shall be recorded as a local alarm.

(b) A Signal/Flash switch that toggles between automatic and flashing operation. To insure the controller exits flash properly, the controller External Start input shall be active in the flash position and inactive in the signal (automatic) position. Activation of the Flash switch shall be recorded as a local alarm.

(c) A Signal/Off switch that toggles power on and off to the controller assembly and signals.

Each switch shall be permanently labeled to identify its function.

3. Main Door Switches. All cabinets shall be provided with the following switches on the main door. These switches shall be accessible only when the main door is open.

(a) Momentary pushbutton switches providing calls to vehicle phases 1 through 8, any concurrent or exclusive pedestrian phases, and calls to intersection pre-empt displays.

(b) A Timer On/Off toggle switch that turns power on/off to the controller only. The MMU and other cabinet equipment shall not be affected by this switch.

(c) A three-position Modem Power switch on all controller assemblies containing modems. This switch shall be labeled “Modem Power” and perform the following functions:

On - When in this switch position, constant power shall be supplied to the modem no matter what the user defined output is set for.

Off - When in this switch position, no power shall be supplied to the modem no matter what the user defined output is set for.

T.O.D. - When in this switch position, power shall be supplied to the modem as a function of the user-defined output controlled by time-of-day programming.

Each switch shall be permanently labeled to identify its function.

h. Controller Cabinet Terminal Strips. All terminal connections shall be marked with a number and, where appropriate, the corresponding NEMA function. All labels shall be silk screened or permanent labels.

i. Lightning Protection.

1. AC Service Protection. The traffic signal control assembly shall be equipped with surge protection installed at the power distribution panel. The surge protector shall be an EDCO ACP 340 filtering surge protector, or approved equal, and shall meet or exceed the following electrical specifications:

(a) Peak Current; 20,000 amps (8x20 microseconds)

(b) Clamp Voltage @ 20kA; 250 volts typ.

(c) Response Time; voltage never exceeds 250 volts during surge

(d) Operating Temperature; -40 to 85 degrees C.

2. Vehicle Loop Detector Protection. Surge protection shall be installed on each loop detector circuit. The surge protection shall be an EDCO SRA6LCA vehicle loop detection surge protection device, or approved equal. The device shall be configured with the type of mounting which best accommodates the type of loop detector lead-in terminal block supplied. It shall meet or exceed the following specifications:

(a) Peak Surge Current
Differential Mode; 400 amps (8x20 microseconds).
Common Mode; 1000 amps (8x20 microseconds).

(b) Estimated Occurrences; 500 @ 200 amps.

(c) Response Time; 40 nanoseconds.

(d) Input Capacitance; 35 picofarads.

(e) Operating Temperature; -40 to 85 degrees C.

(f) Clamp Voltage @ 400 amps differential mode; 30 volts max.

(g) Clamp Voltage @ 1000 amps common mode; 40 volts max.

j. Radio Interference Suppressors. Each cabinet shall be equipped with a radio interference suppressor meeting the requirements of Section 5.4 of the NEMA TS-2 Standards.

k. Cabinet Wiring. As a minimum, cabinets shall be wired in accordance with the NEMA TS-2 Standards, Section 5, Terminals and Facilities, as it applies to Type 1, Configuration 3 cabinets, unless otherwise specified in these Specifications. Any power supplies must be shielded with a non-conductive material to prevent accidental contact. Sealers or compounds that are not non-conductive will not be accepted.

A panel shall be provided suitable for terminating: A minimum of 16 loop lead-ins, Rack Power and Ground, Detector Call Terminations, and Phase 2, 4, 6, and 8 pedestrian pushbuttons.

l. Detector Racks. The cabinet shall provide for a minimum of 16 channels of detection, fully wired for all channels.

Detector channels shall be assigned as shown on the Loop Detector Diagram included on the Plans.

All loop detector units shall be rack mounted. Detector units and racks shall conform to the NEMA TS-2 Standards, Sections 2, 5, and 6. Racks shall be of metal construction, providing top and bottom guides for all slots. Racks shall be bolted to the top shelf of the cabinet using wing nuts to simplify their removal. Where an emergency vehicle priority system is being installed, auxiliary rack positions may be used instead of a separate rack to accommodate the selector modules.

The Contractor shall supply and install on the upper left-hand corner of the back of the cabinet door a laminated intersection graphic and table depicting the traffic detector relay channel assignments. The diagram shall be a graphic of the intersection oriented similar to the Plans showing the locations of each loop detector. The diagram shall, at a minimum, include detector numbers, street names, north arrow (oriented similar to Plans), and controller cabinet location. The assignment information shall be included in a table, which shall include, at a minimum, approach name, detector number, terminal numbers, detector rack slot number, relay number, relay channel number, and the phase associated with each detector.

All detector unit delay and extension timings called for on the Plans shall be programmed in the controller unit, not in the detector unit.

m. Load Switches and Flash Transfer Relays. In addition to the requirements of the NEMA TS-2 Standards, Section 6, Auxiliary Devices, all load switches shall utilize optically isolated, encapsulated modular solid state relays. Discrete components on circuit boards will not be accepted. Load switch indicator lights shall be LED type and wired on the input side of the device.

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

Controller cabinets shall be furnished with a full complement of load switches and flash transfer relays. This requires a load switch and a flash transfer relay for each back panel position, even it the position is not used.

n. Malfunction Management Unit (MMU). The MMU shall conform to the requirements of Section 4 of the NEMA TS-2 Standards.

o. Master or Local Modem. Provisions for a telephone connection in the cabinet shall be provided at all master controller locations and at selected local controllers as specified on the Plans. At these locations a shelf mounted modem shall be supplied. The modem shall provide a full duplex operation using a 2-wire, dial-up telephone line, and comply with Part 66, FCC Docket 19528. The modem shall support the communications rate of the system software and synchronous and asynchronous data transfer.

Originate Manual or Auto Answer operating modes shall be provided. The modem shall provide an Auto Disconnect function that will disconnect the modem due to lack of carrier after 18 seconds. The front diagnostic LEDs shall display, at a minimum, the operational status of the following:

Modem Ready	Terminal Ready	Receive Data	Send Data
Off Hook	Carrier Detect	Auto Answer	High Speed

The modem shall be wired such that it is capable of being powered down and powered up via a user-defined controller output to automatically reset the modem. The user-defined output shall utilize an interface relay in controlling power to the modem. The user-defined output shall be initially programmed to be on at all times except for a one minute interval starting at 1:00 a.m. every day.

The modem reset shall be controlled by a switch on the cabinet door as described in **Subsection M.15.13.2**; **Para. g.3(c)**.

The modem shall include an easily accessible on/off switch operating with power supplied from a controller cabinet duplex outlet. The modem shall have an operating temperature range of -34EC (-30EF) to +74EC (+165EF). Care should be exercised in the organization and construction of the controller cabinet to insure that the opening and closing of the cabinet door does not interfere with the modem's power cable.

p. Bus Interface Unit (BIU). The BIU furnished shall be of the latest manufacture and meet all requirements of Section 8 of the NEMA TS-2 Standards.

M.15.14 DETECTOR RELAYS - LOOP. All detector units shall be rack mounted and meet the provisions of Subsection 6.5; Inductive Loop Detectors of the NEMA Standard Publication No. TS-2, Traffic Controller Assemblies. All delay and extension settings shall be set in the controller unless otherwise directed on the Plans and/or as directed by the Engineer.

M.15.15 VEHICULAR SIGNAL HEADS. Signal heads shall conform to the requirements of the Equipment Standard of the Institute of Transportation Engineers, latest edition. All vehicular signal heads shall be Light Emitting Diode (L.E.D.) Traffic Signal Modules. They shall be 12 inches (300 mm) in diameter, unless otherwise indicated on the Plans.

The L.E.D. signal module shall conform to the requirements of the Purchase Specifications of the Institute of Transportation Engineers, latest edition, for Light Emitting Diode (L.E.D.) Traffic Signal Modules.

An independent laboratory shall certify that the L.E.D. signal module complies with Section 6; Quality Assurance, of the above referenced ITE L.E.D. Purchase Specification.

All L.E.D. lamps shall have a UV stabilized clear lens.

All L.E.D. signal modules shall be warranted against material defects, workmanship and loss of luminous intensity, for a period of 60 months from the time the units are placed in service.

Lamps shall have a minimum of 144 L.E.D.s (light emitting diodes). The lamps shall be wired with parallel circuits, such that one burned out L.E.D. will not affect more than 5 percent of the total circuit.

A filtered power supply engineered to electrically protect the L.E.D.s and maintain a safe and reliable operation shall be provided. In-Line Fusing with a maximum rating of 2 amps shall be provided in the power lead to minimize the effect and repair cost of an extreme over voltage situation or other failure mode. All signals shall be capable of flash operation with no restrictions or degradation of performance.

Lamps shall be provided with 40-inch pigtails. Wires shall be terminated with a crimp style female quick slide 1/4-inch spade lug (16-14 wire size). Lamps shall have color coded 16 AWG wires for identification of heads as follows:

Red L.E.D.	Red with White neutral
Yellow L.E.D.	Yellow with White neutral
Green L.E.D.	Green with White neutral

All modules supplied to be retrofit into existing signal heads shall include a new gasket.

The L.E.D. signal module shall be a single, self-contained device, not requiring on-site assembly for installation into a signal housing. The module shall have a permanent UP ARROW for correctly orienting the module in the signal housing. The manufacturer's name, trademark, serial number and any other necessary identification shall be permanently marked on the backside of the module.

The maximum wattage for a 12-inch (300 mm) ball shall be 25 watts. The maximum wattage for a 12-inch (300 mm) arrow shall be 14 watts.

Red and green arrows, and green/yellow dual indication arrows shall consist of two rows of L.E.D.s. The lamps shall be in parallel circuits such that one burned-out L.E.D. will not affect more than 5 percent of the total circuit.

M.15.16 PEDESTRIAN SIGNAL HEADS. The signals covered under this subsection consist of L.E.D. modules displaying alternating international "HAND" and "WALKING MAN" symbols contained within a weatherproof housing.

L.E.D. signal module shall be a self-contained devise, not requiring on-site assembly for installation. L.E.D. signal modules shall be manufactured to fit in standard 12-inch signal housings as a retrofit replacement for existing signal lamps. All hardware, including screws, washers, nuts and bolts, shall be stainless steel and all other components shall be corrosion resistant. All components shall be readily accessible when the door is open.

The L.E.D. signal module shall consist of a double message overlay combining the “HAND” and “WALKING MAN” symbols. The symbols shall be formed by arranging the L.E.D.s to form an outline of each symbol.

The L.E.D. signal module shall conform to the requirements of the Purchase Specification of the Institute of Transportation Engineers, latest edition, for Light Emitting Diode (L.E.D.) Pedestrian Traffic Signal Modules.

M.15.17 PEDESTRIAN PUSHBUTTON DETECTOR. Pedestrian pushbutton assemblies shall be ADA compatible and shall consist of a round or rectangular cast aluminum enclosure free of voids, pits, dents, excessive foundry grinding marks, and other exterior blemishes. The housing shall come with holes in the bottom and back tapped to accept a ½-inch NPT thread plug. The bottom hole shall be supplied with a threaded plug. The back hole shall be supplied with a non-thread plastic plug or equal.

M.15.18 PAINT COLORS. "Federal Yellow" shall conform to the color standards approved and contained in the "Manual for Signs and Pavement Marking of the National System of Interstate and Defense Highways," standard Interstate colors.

M.15.19 ITEMS REQUIRING A MATERIALS CERTIFICATE AND A CERTIFICATE OF COMPLIANCE. For the following items a Materials Certificate and a Certificate of Compliance will be required confirming their conformance to the requirements set forth in the Special Provisions and/or Plans.

1. Electrical Conduit
2. Stainless Steel Bolts and Nuts
3. Lamps and Luminairies
4. Ballasts (both Multiple and Series)
5. Conductors

SECTION M.16

SIGNS AND SIGN SUPPORTS

M.16.01 SIGN PANELS.

M.16.01.1 Extruded Aluminum.

The panels shall be fabricated of extruded aluminum channels ASTM B221, alloy 6063-T6; and they shall be 0.125-inch thick, 12 inches wide and of bolted joint design. Partial channel sections shall not be allowed except where sign dimensions warrant and then only one such reduced section of six inches shall be permitted per sign panel.

The panels, attachments and hardware shall conform to the requirements and details indicated on the Plans.

Locking tab fastenings engaging the sign stringers and connected to the sign sheets shall be designed with a factor of safety of not less than 1.61 against the minimum yield stress of the material and shall be fabricated of 6061-T6 aluminum alloy material as shown on the Plans.

Stud material shall be aluminum alloy 1100-H16, electrically welded to the sign sheets by the capacitor discharge method.

Hardware required to fasten panels together or to attach signs to posts shall be aluminum or stainless steel. Stainless hardware shall conform to the requirements of ASTM A320. Nuts shall be of the self-locking type.

M.16.01.2 Aluminum Sheets. Aluminum sheets for signs shall conform to ASTM B209, latest issue, alloy 6061-T6. The minimum thickness of sheets shall be as shown on the Plans.

M.16.01.3 Temporary Construction Sign Panels. The plywood shall be of the exterior type and conform to the requirements as set forth in Department of Commerce product standard PSI-66.

Face, core, and cross veneers shall be grade B or better, and the entire area of contacting veneer surface shall be bonded with a waterproof adhesive that meets the test requirements for exterior type.

The overlay shall be of the high density type. Precautions shall be taken during plywood manufacture and subsequent handling to prevent any press caul lubricants, release agents, or other contaminants from coming in contact with the overlay surface.

Thickness, length, and width shall be as shown on the Plans. Sign blanks shall be cut to shape using a saw blade that does not tear plywood grain. Holes shall be clean cut and uniform.

The Contractor may use aluminum sheets for temporary construction signs which meet the requirements of **Subsection M.16.01.2; Aluminum Sheets**, of these Specifications.

The Contractor may also use vinyl rollup signs which meet the requirements for Type II Engineering Grade reflective sheeting.

M.16.02 REFLECTIVE SHEETING.

M.16.02.1 General. The reflective sheeting covered by this Specification shall consist of a retroreflective system having a smooth outer surface. When an adhesive backing is used, the sheeting shall have a precoated adhesive on the back protected by an easily removable liner.

a. Type IIIA and Type IIIB are high performance grade encapsulated lens sheetings with designations "A" for glass bead and "B" for prismatic sheeting.

b. Type IV is a reflectorized, reboundable flexible sheeting designed for channeling devices with markings, and shall meet or exceed the retroreflection requirements, color conformance and all tests in accordance with ASTM D4956.

c. Type V is durable flourescent orange retroreflective sheeting for certain work zone signs.

d. Type VI is a prismatic retroreflective sheeting used for certain outside work zone signs.

AASHTO M268 Type I retroreflective sheeting, Type II engineering grade and Type IIA super engineering grade are not included in these Specifications.

M.16.02.2 Applications.

a. Type IIIA or Type IIIB Sheeting. Type IIIA, or Type IIIB sheeting shall be used on any sign for which Type V or Type VI sheeting is not specified.

b. Type IV Sheeting. Type IV sheeting shall be used on channeling devices with markings, including flourescent traffic cones, drum barricades and plastic pipe-type barricades.

c. Type V sheeting shall be used on:

1. All W20-1 and W21-4 signs.

2. All W3-1a, W3-2a, W4-1, W4-2, W10-1, E5-1 and E5-1a signs within work zones with orange background sheeting choice.

3. All G20 Series.

d. Type VI sheeting shall be used on all R1-1, R1-2, R4-7, R5-1, R5-1a, W3-1a, W3-2a, W4-1, W4-2, W10-1 signs, Hazard Markers Type 1, 3, and Typical End-of-Road Markers, E5-1 and E5-1a series.

M.16.02.3 Material Requirements, Type IIIA, IIIB, and Type IV Sheeting.

a. Color Requirements. The colors specified shall conform to the applicable requirements of AASHTO M268 except modified as follows:

1. Silver is an acceptable color designation for white.

The purchaser may accept colors by certification or may require the Contractor to provide copies of laboratory test reports to substantiate compliance with contract color requirements.

When testing is required, the test instrument used shall be one of the following or an approved equal:

GARDNER Model AC-2a Color Difference Meter or Model XL 30 Color Difference Meter.

HUNTERLAB D25 Color Difference Meter

Test panels shall be mounted in accordance with the manufacturer's recommendations.

b. Specific Intensity Per Unit Area (SIA). The reflective sheeting shall have the minimum SIA requirements as shown in Tables 1 and 2 for the Type(s) of sheeting specified. SIA is expressed in "candelas per foot candle per square foot" (candelas per lux per square meter). Measurement of SIA shall be conducted in accordance with the applicable requirements. Test panels shall be mounted in accordance with manufacturer's recommendations.

Table 1

Minimum Specific Intensity Per Unit Area (SIA)
(candelas per footcandle per square foot)

Type III Sheeting

A -- Glass Bead Reflective Element Material

Observation Angle (°)	Entrance Angle (°)	White	Red	Orange	Yellow	Green	Blue
0.2	-4	250	45	100	170	45	20.0
0.2	+30	150	25	60	100	25	11.0
0.5	-4	95	15	30	62	15	7.5
0.5	+30	65	10	25	45	10	5.0

B -- Prismatic Reflective Element Material

Observation Angle (^{O})	Entrance Angle (^{O})	White	Red	Orange	Yellow	Green	Blue
0.2	-4	250	45.0	100	170	45.0	20.0
0.2	+30	95	13.3	26	64	11.4	7.6
0.5	-4	200	28.0	56	136	24.0	18.0
0.5	+30	65	10.0	25	45	10.0	5.0

Table 2
Minimum Specific Intensity per Unit Area (SIA)
(candelas per lux per square meter)

Type IV Sheeting

Observation Angle (^{O})	Entrance Angle (^{O})	White	Flourescent Orange
0.2	-4	550	180
0.2	+30	330	100

c. Specular Gloss. The reflective sheeting shall have an 85 degree specular gloss of not less than 50 for Types IIIA, IIIB, and IV when tested in accordance with ASTM D523.

d. Color Processing. Color processing shall be in accordance with the applicable requirements of AASHTO M268.

e. Shrinkage. Shrinkage shall be in accordance with the applicable requirements of AASHTO M268 except the shrinkage of Type III reboundable sheeting shall not be more than 0.10-inch in 24 hours in any dimension.

f. Flexibility. Type III and IV sheeting, with the liner removed and conditioned for 24 hours at 72°F (22°C) and 50 percent relative humidity shall be sufficiently flexible to show no cracking when slowly bent around a 1/8-inch (3.2 mm) mandrel with adhesive contacting the mandrel. For ease of testing, spread talcum powder on adhesive to prevent sticking to mandrel. The test specimen shall be 2¾-inches by 11 inches.

Non-adhesive sheetings shall show no signs of cracking or crazing when flexed repeatedly over a 1/16-inch mandrel to 180 at 72°F.

Type III reboundable sheeting shall be conditioned and tested at 32°F.

g. Adhesive. When an adhesive is used, the reflective sheeting shall have either a pressure sensitive adhesive backing (Class 1) or a heat activated adhesive backing (Class 2) which

shall provide for application of the sheeting without the necessity of additional adhesive coats on either the reflective sheeting or application surface.

The Class 1 adhesive shall be a pressure sensitive adhesive of the aggressive tack type requiring no heat, solvent, or other preparation for adhesion to smooth clean surfaces. The Class 2 adhesive shall be an adhesive activated by applying heat in excess of 175°F (73°C) to the material as in the heat-vacuum process of sign fabrication.

The protective liner attached to the adhesive shall be removed by peeling without soaking in water or other solvents without breaking, tearing or removing any adhesive from the backing. The protective liner shall be easily removed following accelerated storage for 4 hours at 160°F (71°C) under a weight of 2.5 pounds per square inch (0.18 kg/cm^2).

The adhesive backing of the reflective sheeting shall produce a bond to support a 1¾ pound (0.79 kg) weight for 5 minutes, without the bond peeling for a distance of more than 2 inches (5.08 cm) (1 inch for Type III reboundable sheeting) when applied to a smooth aluminum surface and tested as specified.

h. Impact Resistance. The impact resistance of Type III and IV reflective sheeting shall conform to the applicable requirements of AASHTO M268 with the following exception: For Type III reboundable and Type IV sheeting, a 100 inch-pound setting shall be used on the test instrument. Type III reboundable sheeting shall also be further conditioned and tested at 32°F.

i. Accelerated Weathering. When applied in accordance with recommended procedures, the reflective sheeting shall be weather resistant and, following cleaning in accordance with manufacturer's recommendations, shall show no appreciable discoloration, cracking, blistering or dimensional change. Following exposure, the panels shall be washed with a 5 percent hydrochloric acid solution for 45 seconds, rinsed thoroughly with clean water, blotted with a soft clean cloth, brought to equilibrium at standard conditions and tested. It shall have not less than the percent of the minimum SIA specified in Table 3 when subjected to accelerated weathering in accordance with ASTM G23, Type E or EH Weatherometer with humidifier off.

Table 3
Accelerated Weathering Testing Requirements

Type III & IV Sheeting

Type of Material	Hours Tested	Minimum Specific Intensity Per Unit Area
III	*2,200	80% of Table 1
IV	250	50% of Table 2

* For orange material having glass bead retroreflective elements and for Type III reboundable sheeting, the hours tested shall be 500.

M.16.02.4 Material Requirements - Type V Sheeting

a. Photometric - Coefficient of Retroreflection R_A. When the sheeting applied on aluminum test panels is measured in accordance with ASTM E810, it shall have minimum coefficient of retroreflection values as shown in Table 4. The rotation angle shall be 90°, the observation angles shall be 0.2^O, and 0.5^O, the entrance angels (component B1) shall be -4°, and $+30^O$, and the entrance angle component B2 shall be 0°.

Table 4
Minimum Coefficient of Retroreflection R_A
(candelas per footcandle per square foot)
(90° Rotation Angle)

Type V Sheeting

Observation Angle (^{O})	Entrance Angle (^{O})	Orange
0.2	-4	200
0.2	+30	90
0.5	-4	80
0.5	+30	50

b. Daytime Color. Color shall conform to the requirements of Table 5. Daytime color and maximum spectral radiance factor (peak reflectance) of sheeting mounted on aluminum test panels shall be determined instrumentally in accordance with ASTM E991. The values shall be determined on a Hunter Lab Labscan 6000 0/45 Spectrocolorimeter with option CMR 559 [or approved equal 0/45 (45/0) instrument with circumferential viewing (illumination)]. Computations shall be done in accordance with ASTM E308 for the 2^O observer.

Table 5
Color Specification Limits* (Daytime)

Type V Sheeting

									Reflectance Limit Y (%)	
Color	1		2		3		4			
	x	y	x	y	x	y	x	y	min.	max.
Orange (new)	.583	.416	.523	.397	.560	.360	.631	.369	30	–
Orange (weath-ered)	.583	.416	.523	.397	.560	.360	.631	.369	20	45
Maximum spectral radiance factor, new: 110%, min. - weathered: 60%										

c. Nighttime Color. Nighttime color of the sheeting applied to aluminum test panels shall be determined instrumentally in accordance with ASTM E811 and calculated in the u', v' coordinate system in accordance with ASTM E308. Sheeting shall be measured at 0.33^{O} observation and -4° entrance at 90° rotation. Color shall conform to the requirements of Table 6.

Table 6
Color Specification Limits* (Nighttime)

Type V Sheeting

Color	1		2		3		4	
	u'	v'	u'	v'	u'	v'	u'	v'
Orange (new and weather-ed)	.400	.540	.475	.529	.448	.522	.372	.534

* The four pairs of chromaticity coordinates determine the acceptable color in terms of the CIE 1931 standard colorimetric system measured with standard illuminant D65.

d. Resistance to Accelerated Weathering. The retroreflective surface of the sheeting shall be weather resistant and show no appreciable cracking, blistering, crazing, or dimensional change after one year of unprotected outdoor exposure in south Florida, south-facing and inclined 45° from the vertical, or after 1500 hours of exposure in a xenon arc weatherometer in accordance with ASTM G26, Type B, Method A. Following exposure, panels shall be washed in a 5 percent HCL solution for 45 seconds, rinsed thoroughly with clean water, blotted with a soft clean cloth and brought to equilibrium at standard conditions. After cleaning, the coefficient of retroreflection shall be not less than 100 when measured as indicated in **Para. d.2** of this Subsection, and the color is expected to conform to the requirements of Tables 5 and 6 for weathered sheeting. The sample shall:

1. Show no appreciable evidence of cracking, scaling, pitting, blistering, edge lifting or curling or more than 1/32-inch (0.08 cm) shrinkage or expansion.

2. Be measured only at angles of 0.2^{O} observation, -4° entrance and 90° rotation. Where more than one panel of a color is measured, the coefficient of retroreflection shall be the average of all determinations.

e. Impact Resistance. The retroreflective sheeting applied according to the sheeting manufacturer's recommendations to a test panel of alloy 6061-T6, 0.040" (0.10 cm) by 3" (7.6 cm) by 5" (12.7 cm) and conditioned for 24 hours, shall show no cracking outside the impact area when the face of the panel is subjected to an impact of 100 inch-pounds (11.3 Nm), using a weight with a 5/8-inch (15.8 mm) diameter rounded tip dropped from a height necessary to generate an impact of 100 inch-pounds, at test temperatures of both 32°F (0°C) and 72°F (22°C).

f. Resistance to Heat. The retroreflective sheeting, applied to a test panel as in **Para. e**, above, and conditioned for 24 hours, shall be measured in accordance with **Para. a** at 0.2^{O} observation and -4° entrance angles at 90° rotation and exposed to 170± 5°F (77± 3°C) for 24

hours in an air circulating oven. After heat exposure the sheeting shall retain a minimum of 70 percent of the original coefficient of retroreflection.

g. Field Performance. Retroreflective sheeting processed and applied to sign blank materials in accordance with the sheeting manufacturer's recommendations, is expected to perform effectively. The retroreflective sheeting will be considered unsatisfactory if it has deteriorated due to natural causes to the extent that 1) the sign is ineffective for its intended purpose when viewed from a moving vehicle under normal day and night driving conditions; or 2) the coefficient of retroreflection is less than 100 when measured at 0.2^{O} observation and -4° entrance at 90° rotation. All measurements shall be made after sign cleaning according to the sheeting manufacturer's recommendations.

M.16.02.5 Material Requirements - Type VI Sheeting

a. Coefficient of Retroreflection, R_A. The coefficients of retroreflection shall not be less than the minimum values specified in Table 7. Testing shall be in accordance with ASTM D4956, latest edition.

Units: Coefficients of retroreflection R_A shall be specified in units of candelas per lux per square meter (candelas per footcandle per square foot).

The observation angles shall be as per ASTM D4956, latest edition.

For colored, transparent overlay films and for screen printed transparent color areas on white sheeting, the ratios of the R_A for the white to the R_A for the color, when measured at 0.2^{O} observation, -4° entrance, and 0° rotation, shall be 5:1 to 15:1 for red, not less than 5:1 for blue and not less than 5:1 for green when processed in accordance with the sheeting manufacturer's recommendations.

Table 7
Minimum Coefficient of Retroreflection R_A
(candelas per lux per square meter)

Type VI Sheeting - ASTM D4956, Latest Edition

Observation Angle (^{O})	Entrance Angle (^{O})	Rotation Angle (^{O})	White	Yellow	Blue	Green
0.2	-4	0	430	350	20	45
0.2	+30	0	235	190	11	24
0.33	-4	0	300	250	15	33
0.33	+30	0	150	130	7	18
0.5	-4	0	250	200	10	25
0.5	+30	0	170	140	7	19
1.0	-4	0	28	22	2.4	5.0
1.0	+30	0	16	12	1.0	2.7

b. Color Requirements. Conformance to color requirements of Table 8 shall be determined by instrumental method in accordance with ASTM E1164 on sheeting applied to aluminum test panels. The values shall be determined on a HunterLab Labscan 6000 0/45 Spectrocolorimeter with option CMR 559 [or approved equal 0/45 (45/0) instrument with circumferential viewing (illumination)]. Computations shall be done in accordance with ASTM E308 for the 2^{O} observer.

Table 8
Color Specification Limits* (Daytime)

Type VI Sheeting

									Reflectance Limit Y (%)	
Color	1		2		3		4			
	x	y	x	y	x	y	x	y	min.	max.
White	0.305	0.305	0.355	0.355	0.335	0.375	0.285	0.325	40	–
Yellow	0.487	0.423	0.545	0.454	0.465	0.534	0.427	0.483	24	45
Blue	0.078	0.171	0.150	0.220	0.210	0.160	0.137	0.038	1	10
Green	0.030	0.398	0.166	0.364	0.286	0.446	0.201	0.794	3	9

* The four pairs of chromaticity coordinates determine the acceptable color in terms of the CIE 1931 standard colorimetric system measured with standard illuminant D65.

c. Gloss. The retroreflective sheeting shall have an 85° specular gloss of not less than 50 when tested in accordance with ASTM D523.

d. Color Processing. The retroreflective sheeting shall permit cutting and color processing with compatible transparent and opaque process colors in accordance with the sheeting manufacturer's recommendations at temperatures of 15 to $38^{O}C$ (59 to $100^{O}F$) and relative humidities of 20 percent to 80 percent. The sheeting shall be heat resistant and permit force curing without staining of applied or unapplied sheeting at temperatures recommended by the sheeting manufacturer.

e. Flexibility. The retroreflective sheeting with the liner removed and conditioned at standard conditions shall be sufficiently flexible to show no cracking when slowly bent, in one second's time, around a 3 mm (1/8 inch) mandrel, with the adhesive contacting the mandrel, at test conditions. Talcum powder shall be spread on the adhesive to prevent sticking to the mandrel.

f. Adhesive. The protective liner attached to the adhesive shall be removed by peeling without soaking in water or other solutions, without breaking, tearing, or removing any adhesive from the backing. The protective liner shall be easily removed following accelerated storage for 4 hours at $70^{O}C$ ($158^{O}F$) under a weight of .175 Kg/cm^2 (2.5 pounds per square inch). The adhesive backing of the retroreflective sheeting shall produce a bond to support a .80 Kg (1.75 pound) weight for 5 minutes without the bond peeling for a distance of more than 5.0 cm (2 inches) when applied to a test panel. Apply 10 cm (4 inches) of a 2.5 cm x 15 cm (1" x 6") specimen to a test panel.

Condition and then position the panel face down horizontally, suspend the weight from the free end of the sample and allow it to hang free at an angle of 90° to the panel surface for 5 minutes.

g. Impact Resistance. The retroreflective sheeting applied according to the sheeting manufacturer's recommendations to a test panel of alloy 6061-T6, 0.10 cm (0.040 inches) by 7.5 cm (3 inches) by 12.5 cm (5 inches) and conditioned at standard conditions, shall show no cracking outside the impact area when the face of the panel is subjected to an impact of 5.65 Nm (50 inch-pounds) using a weight with a 1.6 cm (5/8 Inch) diameter rounded tip dropped from a height necessary to generate an impact of 5.65 Nm, at test temperatures of both 0°C (32°F) and 22°C (72°F).

h. Resistance to Accelerated Outdoor Weathering. The retroreflective surface of the sheeting shall be weather resistant and show no appreciable cracking, blistering, crazing, or dimensional change after two years unprotected outdoor exposure, facing the equator and inclined 45° from the vertical. Following weather exposure, panels shall be washed in a 5% HCL solution for 45 seconds, rinsed thoroughly with clean water, blotted with a soft clean cloth and brought to equilibrium at standard conditions. After cleaning, the coefficient of retroreflection shall not be less than the values in Table 9 when measured at 0° rotation and the colors shall conform to the requirements of Table 8. The sample shall:

1. Show no appreciable evidence of cracking, scaling, pitting, blistering, edge lifting or curling or more than 0.8 mm (1/32 inch) shrinkage or expansion;

2. Be measured only at angles of 0.2^{O} observation, -4° entrance, and 0° rotation, and 1.0^{O} observation, -4° entrance, and 0° rotation. Where more than one panel of a color is measured, the coefficient of retroreflection shall be the average of all determinations.

Table 9
Minimum Coefficient of Retroreflection R_A
after Accelerated Outdoor Weathering
(candelas per lux per square meter)

Type VI Sheeting

Observation Angle (^{O})	Entrance Angle (^{O})	Rotation Angle (^{O})	White	Yellow	Blue	Green
0.2	-4	0	250	200	11	25
1.0	-4	0	45	35	1.3	3

i. Resistance to Heat. The retroreflective sheeting, applied to a test panel and conditioned at standard conditions, shall be measured for retroreflectance at 0.2^{O} observation and -4° entrance angles and 0° rotation and exposed to 77± 3°C (170± 3°F) for 24 hours in an air circulating oven. After heat exposure the sheeting shall retain a minimum of 70 percent of the original coefficient of retroreflection when measured at room temperature.

j. Resistance to Corrosion. The retroreflective sheeting applied to a test panel and conditioned at standard conditions shall show no loss of adhesion, appreciable discoloration or corrosion and after cleaning shall retain a minimum of 80 percent of the original coefficient of retroreflection when measured at 0.2^{O} observation, -4° entrance and 0° rotation angles after 1000 hours exposure to a 5 percent concentration of salt spray at $35^{O}C$ ($95^{O}F$) when tested in accordance with ASTM B117.

k. General Characteristics and Packaging. The retroreflective sheeting as supplied shall be of good appearance, free from ragged edges, cracks and extraneous materials, and shall be furnished in either rolls or sheets. When furnished in continuous rolls, the average number of splices shall not be more than 3 per 50 meters (54.7 yards) of material with a maximum of 4 pieces in any 50 meter (45.7 yard) length. Splices shall be butted or overlapped and shall be suitable for continuous application as furnished. When furnished as cut sheets or sign faces, the sheeting shall be packaged flat in accordance with commercially accepted standards. The sheeting shall be packed snugly in corrugated fiberboard cartons, in accordance with commercially accepted standards. Each carton shall clearly stipulate the brand, quantity, size, lot or run number and color. Stored under normal conditions the retroreflective sheeting as furnished shall be suitable for use for a minimum period of one year.

l. Performance Requirements and Obligations.

1. Certification. The sheeting manufacturer shall, upon request, supply with each lot or shipment, a certification which states that the material supplied will meet all of the requirements listed herein.

2. Field Performance Requirements. After ten years in service the coefficient of retroreflection shall not be less than the values listed in Table 10.

Table 10
Minimum Coefficient of Retroreflection R_A
after Ten Years
(candelas per lux per square meter)

Type VI Sheeting

Observation Angle (^{O})	Entrance Angle (^{O})	White	Yellow	Blue	Green
0.2	-4	250	200	10	23
1.0	-4	45	35	2	5

All measurements shall be made after sign cleaning according to the sheeting manufacturer's recommendations.

Natural causes include effects of exposure to weather. Natural causes exclude (without limitation) damage from exposure to chemicals, abrasion and other mechanical damage from fasteners used to mount the sign, collisions or mishandling.

For screen printed transparent colored areas on white sheeting, the coefficients of retroreflection shall maintain the ratios required for new sheeting.

3. Process Inks. The manufacturer of the sheeting shall furnish at no additional cost the process inks, clears and thinners recommended for the sheeting to meet the performance requirements of this Specification, and shall further be responsible for technical assistance in the use of these inks in accordance with this Specification.

4. Slip Sheet. Slip sheet paper, if recommended by the sheeting manufacturer for sheeting surface protection or for use in packaging, storage or shipping finished signs, shall be furnished in rolls by the manufacturer at no additional charge, in at least equal dimension (square meters) and in the same sizes as the sheeting supplied.

5. Washers. Washers, if recommended by the sheeting manufacturer to protect the sign surface from damage by bolts or other fasteners, shall be furnished by the manufacturer at no additional charge.

m. Fabrication Date. The sign fabricator shall date all signs at the time of fabrication with the fabrication date so that the start of the warranty period can be determined.

M.16.02.6 Testing Procedures.

a. Testing Conditions. Unless otherwise specified herein, all applied and unapplied test samples and specimens shall be conditioned at the standard conditions of 23± 3°C (73± 3°F) and 50±5 percent relative humidity for 24 hours prior to testing.

b. Testing Panels. Unless otherwise specified herein, when tests are to be performed using test panels, the specimens of retroreflective material shall be applied to smooth aluminum cut from ASTM B209 Alloy 5052-H36, 5052-H38, 5154-H38 or 6061-T6 sheets in 0.05 cm (0.020 inch), 0.10 cm (0.040 inch) or 0.16 cm (0.063 inch) thickness. The aluminum shall be degreased and lightly acid etched before the specimens are applied. The specimens shall be applied to the panels in accordance with the recommendations of the retroreflective sheeting manufacturer.

c. Specific Intensity Per Unit Area (SIA). Measurements shall be conducted in accordance with Instrumental Photometric Measurements of Retroreflective Materials and Retroreflective Devices, Federal Test Method Standard 370. Test will be conducted at 50 feet with 1-inch source and 1-inch receiver on 12-inch square test specimen. Observation and entrance angles shall be in the same plane.

Rotate specimen to orientation angles recommended by the manufacturer. The presentation angle is zero.

The SIA of the sheeting when totally wet, shall not be less than 90 percent of the dry values in Tables 1, 2, 4 and 7. Wet performance measurements shall be made on new sheeting in accordance with the standard rainfall test specified in Section 7.10.1 of AASHTO M268.

d. Adhesion Test. Adhesion test shall be in accordance with the applicable requirements of AASHTO M268.

e. Colorfastness. The colorfastness test shall be in accordance with the applicable requirements of AASHTO M268 except that the specimens shall be prepared and subjected to accelerated weathering as specified above.

f. Fungus Resistance. For use in areas where fungus growth may be a problem and if specified by the Engineer, fungus resistance shall be determined as specified herein.

After inoculation with the test organism, Aspergillus niger, and incubation for 14 days, the reflective material shall show no appreciable formation of fungus growth. Any formation of fungus growth shall be non-injurious to the reflective material and shall be removable by wiping with a soft cloth. After completion of the incubation and after being wiped clean, the reflective material shall retain the full SIA values as specified in Tables 1, 2, 4 and 7.

1. Test Organism. The test organism used in this test shall be **Aspergillus Niger, ATCC No. 6275**. (This organism may be obtained upon request from the American Type Culture Collection (ATCC), 12301 Parklawn Drive, Rockville, Maryland 20852, or Mycology Laboratory, PRL, U.S. Army Natick Laboratories, Natick, Massachusetts 01760.) Cultures of this organism shall be carefully maintained on a potato-dextrose agar medium and promptly renewed if there is evidence of contamination. The stock cultures may be kept for not more than 4 months in a refrigerator at a temperature from 37.4^{O}F to 50°F (3°C to 10°C). Subcultures incubated at 82.4^{O}F to 86°F (28°C to 30°C) for 10 to 14 days shall be used in preparing the inoculum.

2. Culture Medium. The culture medium shall have the following composition:

$NaNO_3$	- 3.0 grams
K_2HPO_4	- 1.0 grams
$MgSO_47H_2O$	- 0.5 grams
KCl	- 0.25 grams
Agar	-15.0 grams
Distilled water to make 1,000 ml.	

The pH shall be 5.5 to 6.5: if otherwise, adjust to that range with HCL or NaOH. After mixing, the ingredients shall be sterilized by autoclaving for 15 minutes at 15 psi (1.05 kg-cm^2) at 248°F (120°C).

Under sterile conditions, the medium shall be poured into 6, 150 mm by 20 mm petri dishes, about 65 ml per dish, and allowed to harden.

3. Inoculum. Add about 10 ml of sterile, distilled water containing about 0.005 percent of nontoxic wetting agent to a subculture (10 to 14 days old) of the test organism in a ripe, fruiting condition. The spores shall be forced into suspension with a sterile camel's hair brush (or other suitable means) and diluted to 100 ml with sterile, distilled water.

4. Preparation of Specimens. Cut three, 3" x 3" (7.62 cm by 7.62 cm) specimens from the sample and apply to test panels with the reflective surface up. Completely immerse the test specimens in a leaching tank of continuously flowing water for 24 hours and then remove and dry. The leaching tank shall be large enough to hold an amount of water weighing not less than 50 times the weight of the specimens. The water entering the tank shall not fall directly on the specimens and shall flow at a rate of 5 to 10 liters per hour. The pH of the water shall be in the range of 6.0 to 8.0.

5. Inoculation. Under aseptic conditions, dip each specimen in 70 percent ethanol for a few seconds, rinse in distilled water, and place firmly on the surface of the solidified agar medium contained in the petri dishes. Place specimens with the reflective surface facing up, one specimen to each dish. With a sterile pipette, distribute 1.0 to 1.5 ml of inoculum over the surface of each specimen and the surrounding medium.

6. Incubation Period. The period of incubation shall be 14 days at a temperature of 84.2^{O}F to 89.6^{O}F (29°C to 32°C) and 85 to 90 percent relative humidity.

7. Control. Test three control specimens of untreated, porous grade filter paper with the specimens of the reflective material to check the viability of the inoculum. At the end of the incubation period, the controls should be covered with fungus growth.

8. Test Results. Upon completion of the incubation period, examine the specimens visually for fungus growth. Wipe the specimens with a soft cloth wet with a 70 percent ethanol solution. Condition the specimens at standard conditions for 48 hours. Test the specimens in accordance with **Para. c** of this Subsection, and when finished, attempt to remove specimen from the test panel.

M.16.02.7 Intended Use. The reflective sheeting specified herein is intended for use on surfaces of highway signs to assure their optimum visibility by day and at night when exposed to a light source and whether dry or totally wet by rain.

Purchasers should select colors and preferred options permitted herein and specify the type of adhesive backing: Class 1, precoated pressure sensitive adhesive; or Class 2, heat activated adhesive as required.

M.16.03 CUTOUT LETTERS, SYMBOLS AND ACCESSORIES.

M.16.03.1 Description. Cutout letters, digits, and alphabet accessories shall be fabricated in either of the following manners:

a. Embossed aluminum frames in which prismatic reflectors are installed so as to be an integral part of the character, or otherwise securely affixed to prevent their displacement in handling or service. Letters in which reflectors are assembled by means of tape are unacceptable.

b. Adhesive coated reflective sheeting shall be permanently adhered to flat aluminum backing. The reflective sheeting shall conform to the applicable provisions for Type IIIA silver sheeting as specified in **Subsection M.16.02; Reflective Sheeting.**

M.16.03.2 Detailed Specifications.

a. Design and Fabrication of Frames Using Prismatic Reflectors. Letter design shall be the Federal Standard Alphabet Series "D" and "E" modified to accommodate the required reflectors.

All items shall be fabricated from .040-inch sheet aluminum.

Mounting holes shall be provided within the frames to permit the use of screws, rivets, or other common fasteners.

The size and spacing of reflector holes shall be such as to afford maximum night legibility and visibility to the finished cutout figure.

b. Finishing of Frames. After metal fabrication has been completed, the aluminum frames shall be degreased, etched, neutralized, and chemically treated before being finished in an approved baking white enamel.

c. Prismatic Reflectors. The reflectors shall consist of a transparent acrylic plastic face, herein referred to as the lens, and an opaque back fused to the lens under heat and pressure around the entire perimeter to form a unit permanently sealed against dust, water and water vapor. The reflector lens shall be colorless, yellow, red or green.

The lens shall consist of a smooth front surface free from projection or indentations other than for identification, and a rear surface bearing a prismatic configuration such that it will effect total internal reflection of light. The manufacturer's trademark shall be molded legibly into the face of the lens.

The reflector lens shall be methyl methacrylate meeting requirements of Federal Specification L-M-500a, Type I, Class 3.

d. Design and Fabrication of Characters Reflectorized with Encapsulated Lens Reflective Sheeting. Letter design shall conform to Bureau of Public Roads standards for use on National System of Interstate and Defense Highways.

Characters shall be a minimum of .032-inch thick aluminum sheets of 3003 H14 alloy. Aluminum shall be properly treated according to sheeting manufacturer.

M.16.04 SIGN SUPPORTS AND STRUCTURES.

M.16.04.1 General. Signs, sign panel supporting frames and overhead sign support structures, including anchor bolts and foundations, shall conform to the latest edition of the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals.

Steel poles, posts, channel posts, U-channels or other required shapes shall be galvanized and otherwise conform to the Plans and applicable Sections of these Specifications.

Anchor bolts shall be hot-rolled steel conforming to ASTM A325 or a substitute approved in advance by the Engineer. Anchor bolts shall be of the proper size and length to develop proper bond in transferring loads to concrete foundations and possess a minimum yield strength of 50,000 psi.

M.16.04.2 Design of Overhead Sign Structures. Prior to fabrication, the Contractor shall furnish in triplicate, computations containing the design stresses and allowable stresses for each complete structure. All plans and computations shall bear the seal of a Rhode Island Registered Professional Engineer.

Cantilever sign supports shall consist of dual arms with a minimum 0.14 inch per foot taper on the arms. Columns may either be tapered on non-tapered members.

All overhead span sign structures shall consist of a single horizontal steel member supported by steel columns at either side. The columns and horizontal members may be either tapered or non-tapered.

Cantilever sign structures on interstate or limited access highways must comply with fatigue Category I requirements, including galloping, vortex shedding (if applicable), natural wind gusts and truck induced gusts. The truck induced loading will be based on 65 mph velocity.

Cantilever sign structures on other roadways must comply with fatigue Category II requirements of the AASHTO Standards, including galloping, vortex shedding (if applicable), natural wind gusts and truck induced gusts. The truck induced loading will be based on 30 mph velocity.

The basic wind speed used in the determination of the design wind pressure shall be 130 mph.

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 concrete. When the clearance between the bottom of the leveling nuts and the top of the concrete is equal to or greater than one bolt diameter, bending stresses in the anchor bolts shall be considered in the design.

Use of grout under base plates shall generally not be permitted. If specific conditions warrant its use, the grout shall be considered non-load bearing. Loads shall be directly supported by the anchor bolts.

The following notes shall be included on all plans and/or shop drawings in reference to anchor bolts:

> Pretensioning of all anchor nuts is required, and shall be accomplished by tightening to 1/6th turn beyond the snug-tight position.
>
> The maximum clearance between the bottom of the leveling nuts and the top of the concrete is critical and shall not exceed the amount specified on this drawings.

Vibration mitigation devices will not be allowed.

M.16.04.3 Overhead Sign Structures - Steel. Pipes for end support columns, cantilever arms and horizontal span members shall conform to the requirements of ASTM A53, Grade B.

Stainless steel plates shall conform to the requirements of ASTM A240, Type 304.

Base plates and attached stiffener plates shall conform to the requirements of ASTM A588.

All other elements except bolts and nuts shall conform to the requirements of ASTM A36.

After complete fabrication, each of the fabricated steel sections of all sign supports shall be hot-dip galvanized in accordance with the requirements of ASTM A123.

High strength bolts, nuts, and washers shall conform to the requirements of ASTM A325, and shall be hot-dip galvanized in accordance with the requirements of ASTM A153, Class C.

Headed cast-in-place anchor bolts shall be used in lieu of hooked anchor bolts.

All nuts for high strength bolted connections including nuts for anchor bolts shall be "prevailing torque-reusable type" locking nuts.

All U-bolts shall conform to the requirements of ASTM A36 and shall be hot-dip galvanized in accordance with the requirements of ASTM A153.

Stainless steel bolts shall conform to the requirements of ASTM A193, Grade B8, and shall conform to the requirements of ASTM A194, Grade 8. Stainless steel lock washers shall conform to the requirements of ASTM A167, Type 302.

M.16.04.4 Ground Mounted - Breakaway. All materials utilized for foundations, sign supports, hardware, and attachments shall conform to the breakaway design indicated on the Plans. Foundations shall be constructed of Class A(AE) concrete, and reinforcing steel shall conform to the requirements of **Subsection M.05.01** of these Specifications.

M.16.04.5 Directional, Regulatory, and Warning Sign Mountings.

a. Wood Posts. Wood posts shall be cut from well-seasoned, straight, sound, southern yellow pine, Grade No. 2 or better, dressed on four sides and shall be treated with chromated copper arsenate Type C in accordance with AASHTO M133-86, prior to the mounting of the sign to the post. Mounting hardware shall be of the theft resistant type as indicated on the Department's Approved Materials List.

b. Tubular Square Post. Tubular steel posts shall be 2-inch or 2½-inch square 12-gauge tubing with bracing, anchorage and breakaway supports as shown on the Plans.

c. U-Channel. U-channel posts for directional, regulatory, and warning signs shall be 4 pounds per foot as shown on the Plans. U-channels shall be galvanized in accordance with ASTM A123.

M.16.04.6 Street Sign Posts and Brackets.

a. Tubular Steel Posts. Posts for supporting street signs shall be tubular steel with an outside diameter of 2⅜-inches with a wall thickness of 0.64-inch and a minimum weight of 1.64 pounds per foot. All steel posts shall be galvanized in accordance with ASTM A153 and be free of slivers, cracks, burrs and other manufacture imperfections.

b. Brackets and Hardware. Street name sign brackets shall consist of Post to Sign (Post Top) bracket and a Sign to Sign (Cross) bracket. The brackets shall be of the appropriate design and size for mounting extruded aluminum street name sign blades with a .091 minimum gauge and of lengths up to 48 inches and 9 inches in height. They shall be die-cast of high strength aluminum

alloy #380 with tensile strength of 49,000 psi. The brackets shall be free of holes, pits or flaws and shall not be larger than the inside diameter of the base of the post top bracket to insure proper fit. Where two sign blades are used, the two slots of the cross brackets shall be such that the signs are 90 degrees to each other.

Street name sign brackets to be mounted on traffic signal poles shall consist of either one die-cast aluminum cantilever type L-bracket or one die-cast aluminum wing type bracket. A minimum of two stainless steel straps shall be used to hold each type bracket. All brackets shall be free of pits or flaws and other manufacture imperfections.

Bolts for bolt through slots shall be a 5/18"-18 x ½" 12-point splint head bolt to lock the blade in the bracket.

M.16.04.7 Parking Sign, Mile Marker, and Delineator Posts.

a. Parking Sign Posts. Posts for parking sign mountings shall be U-channel shape made from steel conforming to ASTM A499-64 and galvanized in accordance with ASTM A123. The post shall have a minimum weight of 3 pounds per foot and shall contain 3/8-inch mounting holes spaced 1 inch on center for a minimum length of 5 feet from the top of the post.

b. Mile Marker Post. Posts for mile marker mounting shall conform to the requirements for Parking Sign Posts (Para. a, above), except that mounting holes need only be included for a length of 2'-6" from the top of post.

c. Delineator Posts. Post for delineator mountings shall be U-channel shape made from steel conforming to ASTM A4990-74 and galvanized in accordance with ASTM A123-73. The post shall have a minimum weight of 1.12 pounds per foot and contain 3/8-inch diameter holes for mounting spaced at 1 inch on center for a minimum length of 2'- 6" from the top of the post.

M.16.05 REVIEW AND APPROVAL OF MATERIALS USED IN TRAFFIC SIGN CONSTRUCTION.

M.16.05.1. Requirements. The Contractor will be required to submit, prior to award of the Contract, the source of all items intended to be supplied for this Contract. The Contractor is responsible for obtaining approval of each of these items and he shall request this approval, in writing, from the Engineer.

Wherever, in the Special Provisions or on the Plans, a particular manufacturer's product (Proprietary Item) is specified or indicated, it shall be understood that this represents the standard required, but that a similar product of another manufacturer may be considered as a substitute and approved as an "equal." Should the Contractor desire to use a product which is considered equal to a proprietary item, he shall submit a complete description of the item, together with seven copies of shop drawings, catalog cuts, and/or other descriptive literature which would completely illustrate such items presented for formal approval. This approval does not change the requirements for a Certified Test Report and/or Materials Certificate; and a Certificate of Compliance as called for elsewhere.

The requirements for a Certified Test Report and/or Materials Certificate; and a Certificate of Compliance for each of the individual items set forth in the Special Provisions are contained

below. The Contractor shall make available and supply these documents to the Engineer, in the following manner:

Those materials requiring a Certified Test Report shall have said documents forwarded to the Engineer. Provisional acceptance must be obtained on these documents before the material is incorporated in the project. Final acceptance will be granted upon submission of a Certificate of Compliance after installation of the material.

Those materials requiring a Materials Certificate shall have said documents forwarded to the Engineer. Provisional acceptance must be obtained on these documents before the material is incorporated in the project. Final acceptance will be granted upon submission of a Certificate of Compliance after installation of the material.

The Contractor shall supply these documents to the Engineer wherever required by the Special Provisions, relating to a particular item.

The method of processing for approval all items other than those described herein shall be established by the Engineer.

M.16.05.2 Certified Test Report. A Certified Test Report is a document containing a list of the chemical, metallurgical, electrical, and/or physical results obtained from an actual test of the materials involved and shall attest to the fact that the Specifications are adhered to. The following information will also be required:

1. Name of organization to whom the material is consigned.
2. Quantity of material represented.
3. Means of identifying the consignment, such as label, marking, seal number, lot number, etc.
4. Date and method of shipment.

The Certified Test Report shall be signed by an authorized and responsible agent for the organization manufacturing the material and it shall be notarized.

M.16.05.3 Materials Certificate. A Materials Certificate is a document certifying that the materials, components, and equipment furnished, conform to all requirements of the Plans and/or Special Provisions. Appurtenances, such as miscellaneous hardware, may be covered in total by a single entry. The document shall also include the following:

1. Project to which the material is consigned.
2. Name of Contractor to which material is supplied.
3. Kind of material.
4. Quantity of material represented by the Certificate.
5. Means of identifying the consignment, such as label, marking, seal, lot number, etc.
6. Date and method of shipment.

The Materials Certificate shall be signed by an authorized and responsible agent for the organization supplying the material, and it shall be notarized.

M.16.05.4 Certificate of Compliance. A Certificate of Compliance is a document certifying that the materials, components and/or equipment covered by the previously submitted Certified Test Report and/or Materials Certificate have been installed in the work and that they conform to all the requirements of the Plans and or Special Provisions. Appurtenances, such as miscellaneous hardware, may be covered in total by a single entry. The following information shall also be required on the document:

1. Project Number.
2. Kind of material.
3. Quantity represented by the Certificate.
4. Manufacturer and model number and lot number.

The Certificate of Compliance shall be signed by an authorized and responsible agent for the Prime Contractor, and shall be notarized.

M.16.05.5 Items Requiring a Certified Test Report and/or Materials Certificate; and a Certificate of Compliance. For the following items a Certified Test Report and a Certificate of Compliance will be required confirming their conformance to the requirements set forth in these Specifications, Special Provisions and/or Plans. Should the consignee noted on a Certified Test Report be other than the Prime Contractor, then Materials Certificates shall be required to identify the shipment.

1. Reflective Sheeting
2. Demountable Copy
3. Aluminum Post and Attachment Hardware
4. Aluminum Flat Sheets for Sign Panels
5. Anchor Bolts and Nuts
6. Overhead Sign Support (Complete)
7. Delineators (all)
8. Delineator Posts

SECTION M.17

PAVEMENT MARKINGS

M.17.01 GLASS BEADS - DUAL GRADATION.

M.17.01.1 Scope. This Specification covers the requirements for glass beads which are to be dropped onto white and yellow epoxy resin pavement marking material to produce a highly weather-and-wear resistant reflectorized traffic marking.

M.17.01.2 Detailed Requirements.

a. Reflective Glass Spheres. The glass spheres shall be transparent, clean, smooth and spherically shaped, free of milkiness, pits, or excessive air bubbles and conform to the following specific requirements:

1. Coatings. The spheres shall be coated to enhance their embedment characteristics to the binder. They shall show no tendency to absorb moisture in storage and shall remain free of clusters and hard lumps.

2. Quality Assurance. The spheres shall be segregated into maximum lots of 2,500 pounds and lot numbers shall be stamped onto each. Each lot shall be tested for gradation, rounds and coating and a Certificate of Compliance stating such will accompany each lot.

3. Gradation. The glass spheres shall meet the following gradation requirements when tested in accordance with ASTM D1214:

Type I		Type II	
Sieve Size	**Percent Passing**	**Sieve Size**	**Percent Passing**
10	100	20	95-100
12	95-100	30	80-95
14	80-95	50	9-42
16	10-40	80	0-10
18	0-5	-	-
20	0-2	-	-

4. Roundness. The glass spheres shall have a minimum of 80 percent rounds per screen for the two highest sieve quantities for Types I and II, and no more than 3 percent angular particles per screen for the Type I gradation. The remaining fractions shall typically be no less than 75 percent rounds as tested according to ASTM D1155, Procedure A.

5. Refractive Index. The glass spheres shall have a refractive index of 1.50 to 1.52 when tested according to AASHTO M247.

6. Silica Content. The silica content of the glass spheres shall not be less than 60 percent.

7. Packaging. Reflective glass spheres shall be shipped in moisture resistant bags. Each bag shall be marked with the name and address of the manufacturer, the name and net weight of the material, batch or lot number, and shall include a certified test report stating that they meet the above test requirements.

M.17.02 WATERBORNE PAVEMENT MARKINGS. The paint shall be formulated and processed specifically for service as a binder for beads in such a manner as to produce maximum adhesion, refraction, and reflection.

The paint shall be well mixed in the manufacturing process and shall be free from defects and imperfections that may adversely affect the serviceability of the finished product.

The paint shall not liver, thicken, curdle, gel, settle excessively, or otherwise display any objectionable properties after periods of storage of at least six months and, at any time during such periods, shall be mixed manually as necessary to produce a smooth, uniform consistency throughout.

The paint shall dry on a road surface to an adherent film that will provide proper anchorage and reflection for the finished glass beads when applied as specified. It shall be easily and uniformly applicable with mechanical line-marking equipment and shall have excellent covering properties. The paint shall be suitable for binding glass beads so as to produce a highly weather and wear resistant traffic line.

a. Composition. The paint composition shall be left to the discretion of the manufacturer, as long as the finished product meets the following requirements:

1. The paint shall contain not more than 0.06 percent Lead (ASTM D3335).

2. Volatile Organic Compounds (VOC) shall not exceed 150 grams per liter (ASTM D3960).

3. pH shall be a minimum of 9.6.

4. Pigment Content shall be 58-to-63 percent by weight (ASTM D3723).

5. Non-volatile vehicle shall be 41 percent minimum by weight of total vehicle.

6. Total non-volatile solids shall be 76 percent minimum by weight (ASTM D2697).

7. Weight per gallon shall be a minimum of 13.7 lbs./gal. for white and 13.0 lbs./gal. for yellow (ASTM D1475).

8. The paint viscosity shall be 78-to-95 ku at approximately 75°F (ASTM D562).

9. The closed cup flash point shall not be less than 125°F (ASTM D3941).

b. Color. The color after drying (for white) shall be a flat white, free from tint, furnishing good opacity and visibility under both daylight and artificial light, and shall match Chip No. 37886 of Federal Standard 595. For yellow, the color shall closely match Chip No. 33538 of this particular standard.

c. Dry Opacity. The paint shall have a minimum contrast ratio of 0.92 when tested according to ASTM D2244 at a wet film thickness of 5 mils (Federal Test No. 141).

d. Bleeding. The paint shall have a minimum bleeding ratio of 0.97 when tested in accordance with ASTM D868.

e. Reflectance. The daylight directional reflectance shall be not less than 85 percent for white and not less than 50 percent for yellow (relative to Magnesium Oxide) when measured in accordance with Federal Test Method No. 141.

f. Scrub Resistance. The paint shall pass 300 cycles when tested in accordance with ASTM D2486.

g. Freeze-Thaw Stability. The paint shall display no change in consistency greater than 0 percent when tested in accordance with ASTM D2243.

h. Dry Time. The paint shall dry to a no-tracking condition in not more than 2 minutes. The no-tracking condition shall be determined by actual application on the pavement at a wet film thickness of 15 mils. The line for the test shall be applied with equipment so as to have the paint at the temperature of 120-140°F at the spray gun. This maximum drying time shall not be exceeded when pavement temperature is 45-120°F, and under humidity conditions of 85 percent or less providing that the pavement is dry.

M.17.03 THERMOPLASTIC PAVEMENT MARKINGS.

M.17.03.1 Physical Properties.

a. Color. The thermoplastic material after heating for four hours at 425°F under agitation and cooled to 77°F shall meet the following:

White: Daylight reflectance at 45° to 0° ... 75 percent minimum

Yellow: Daylight reflectance at 45° to 0° ... 45 percent minimum and shall match Color Chip No. 13538 of the Federal Standard Specification 595a.

b. Set Time. When applied at a temperature range of 400° to 425°F and thickness of 1/8-inch to 3/16-inch, the material shall set to bear traffic without tracking or deformation in not more than two minutes when the air temperature is 15°F and not more than ten minutes when the air temperature is 90°F.

c. Bond Strength. After heating the thermoplastic material for four hours at 425°F under agitation, the bond strength to Portland cement concrete shall exceed 180 psi.

d. Cracking and Resistance at Low Temperature. After heating the thermoplastic material for four hours at 425°F under agitation, applied and cooled to 15°F ±3°F shall show no cracks.

e. Impact Resistance. After heating the thermoplastic for four hours at 425°F under agitation and tested, the impact resistance shall be a minimum of 10 inch-pounds.

f. Softening Point. After heating the thermoplastic material for four hours at 425°F under agitation and tested in accordance with ASTM D36, the materials shall have a softening point of 190°F to 230°F.

g. Flowability. After heating the thermoplastic material for four hours at 425°F under agitation and tested for flowability, the percent residue shall not exceed 18 for white thermo-plastic and 21 for yellow.

The temperature-viscosity characteristics shall remain constant throughout repeated reheatings to application temperature and shall show like characteristics from batch to batch. The color shall not change after repeated heatings nor shall it change from batch to batch. Any yellowing or off color shall be cause for rejection of the batch.

h. Yellowness Index. The white thermoplastic material shall not exceed a yellowness index of 0.12.

i. Extended Heating Flowability. After testing the thermoplastic material in accordance with Section 1.2.10 of AASHTO T250, the materials shall conform with the following:

Flowability, percent residue maximum 28.

j. Flash Point. The thermoplastic material shall have a flash point not less than 475°F when tested in accordance with ASTM D92.

k. Storage Life. The material shall meet the requirements of this Specification for a period of one year. The thermoplastic must also melt uniformly with no evidence of skins or unmelted particles for this one-year time period. Any material not meeting the above requirements shall be replaced by the Contractor.

l. Specific Gravity. The specific gravity of the thermoplastic traffic line material shall not exceed 2.20.

m. Methods of Sampling and Testing. The minimum size batch of thermoplastic traffic striping materials sampled and tested shall not be less than 3,000 pounds unless the total order is less than this amount. Any manufacturer not familiar with the technique of making this material should consult the purchaser. A small trial batch should be made prior to making the thermoplastic traffic line in large quantities to make certain the finished product will comply with all the requirements of this Specification.

The material shall be tested in accordance with the appropriate method in Federal Test Method Standard No. 141 appropriate ASTM or AASHTO designation.

The material shall not exude fumes which are toxic, obnoxious or injurious to persons or property when it is heated during application.

M.17.03.2 White Thermoplastic Composition.

a. General. The pigment, beads, and filler shall be uniformly dispersed in the resin. The material shall be free from all skin, dirt and foreign objects and shall comply with requirements according to Table I.

Table I - Composition

Component	White
Binder (alkyd type maleic modified glycerol ester of resin)	20.0% Min.
Glass Beads	30.0% Min.
Titanium Dioxide (ASTM D476, Type II)	10.0% Min.
Calcium Carbonate (96% Min. passing 230 sieve) **and** Inert Fillers (shall not contain silica other than as glass spheres)	40.0% Max.

b. Binder. Binder shall exhibit a maximum acid value of 20. Acid value shall be determined on a sample of composition from which the binder is extracted by means of a suitable

neutral organic solvent, the solvent then being evaporated to obtain a substantially dry sample of binder. Acid values shall be determined in accordance with ASTM D1639.

M.17.03.3 Yellow Thermoplastic Composition. The pigment, beads and filler shall be uniformly dispersed in the resin. The material shall be free from all skins, dirt and foreign objects and shall comply with requirements according to Table II.

Table II - Composition

Component	Yellow Organic Lead-Free Pigment
Binder (alkyd type maleic modified glycol ester of resin)	20.0% Min.
Glass Beads	30.0% Min.
Yellow Pigment	2.0% Min.
Calcium Carbonate (96% min. passing #230 sieve **and** Inert Fillers (shall not contain silica other than as glass spheres)	48.0% Max.

M.17.03.4 Primer/Sealer. The primer/sealer shall be used in conjunction with the thermoplastic line striping material on all concrete surfaces, or may be used on older bituminous concrete surfaces (over 6 months old) if deemed necessary by the Engineer. The primer/sealer used shall be recommended by the thermoplastic manufacturer and shall be applied according to the manufacturer's recommended procedures.

The primer/sealer shall be on the Department's Approved Materials List.

M.17.03.5 Packaging and Labeling Requirements. The thermoplastic traffic line material shall be packaged in suitable containers to which it will not adhere during packaging, shipment or storage. The packages shall consist of wax lined cardboard cartons approximately 14" x 28" x 2" in size and weigh approximately 50 pounds.

Each container label shall designate the color, manufacturer's name, batch number and date of manufacture. Each batch manufactured shall have its own separate number. The label shall warn the user that the material shall be heated in the range of 400°F - 425°F during application.

The Contractor shall assume all costs arising from the use of the patented materials, equipment, devices, or processes and save harmless the purchaser and its duly authorized representatives from all suits at law or action of every nature for, or on account of the use of any patented materials, equipment, devices, or processes.

M.17.04 EPOXY RESIN PAVEMENT MARKINGS.

M.17.04.1 Physical Properties.

a. General. The two-component, 100 percent solids paint shall be formulated and designed to provide a simple volumetric mixing ratio (e.g., 2 part component A to 1 part component B) specifically for service as a hot-spray applied binder for glass beads in such a manner as to produce maximum adhesion, refraction, and reflection. The material shall be composed of epoxy resins and pigments only and meet the following minimum requirements:

1. Color. White - the color (after drying at the specified thickness) shall be a flat white, free from tint, furnishing good opacity and visibility under both daylight and artificial light, and shall match Chip No. 17875 of Federal Standard 595. Yellow - the color (after drying at the specified thickness) shall match Chip No. 13538 of Federal Standard 595.

The paint shall be well mixed in the manufacturing process and shall be free from defects and imperfections that may adversely affect the serviceability of the finished product. The paint shall not liver, thicken, curdle, gel, settle excessively, or otherwise display any objectionable properties after storage. Individual components shall not require mixing prior to use when stored for a maximum of twelve months.

2. Composition. The overall paint composition shall be left to the discretion of the manufacturer, but shall meet the following requirements:

White:	Titanium Dioxide ASTM D476 Type III	20 ±2 percent, by weight
	Epoxy Resin	80 ±2 percent, by weight
Yellow:	Chrome Yellow ASTM D211 Type III	25 ±2 percent, by weight
	Epoxy Resin	75 ±2 percent, by weight

3. Epoxy Content (Component A). The epoxy content of the epoxy resin will be tested in accordance with ASTM D1652 and calculated as the weight per epoxide equivalent (WPE) for both white and yellow.

The epoxy content will be determined by a pigment free basis. The WPE shall meet a target value provided by the manufacturer within a tolerance of ±50.

4. Amine Value (Component B). The amine value shall be tested in accordance with ASTM D2074 to determine its total amine value. The total amine value shall meet a target value provided by the manufacturer within a tolerance of ±50.

The manufacturer may specify an alternate test method for determining the amine value subject to the approval of the Engineer.

5. Toxicity. Upon heating to application temperature, the material shall not exude fumes which are toxic or injurious to persons or property. A certification stating such is required to be submitted to the Engineer.

6. Abrasion Resistance (ASTM D4060). When the abrasion resistance of the material is tested with a CS-17 wheel under a load of 1,000 grams for 1,000 cycles, the wear index shall be no greater than 82.

7. Hardness (ASTM D2240). The Type D durometer hardness of the material shall be not less than 75 nor more than 100 after the material has been conditioned for not less than 72 hours nor more than 96 hours at 23° $\pm 2^{O}$C.

8. Tensile Strength (ASTM D638). The tensile strength of the material shall not be less than 6,000 psi after 72 hours of conditioning at 23° $\pm 2^{O}$C.

9. Compressive Strength (ASTM D695). The compressive strength of the material shall not be less than 12,000 psi after 72 hours of conditioning at 23° $\pm 2^{O}$C.

10. Infrared Spectrophotometer Analysis (ASTM D2621). Samples of both Part A and Part B (and of that mixed to the proper ratio) shall be analyzed by infrared spectrography. The spectrum of each component and final product shall be a reasonable match to the spectrum of the original formulation submitted by the manufacturer.

11. Directional Reflectance (ASTM E1347). The daylight directional reflectance (without glass spheres) shall be not less than 84 percent for white and not less than 50 percent for yellow (relative to Magnesium Oxide).

12. Dry Time - Laboratory (ASTM D711). The epoxy resin compounds, when mixed in the proper ratio and applied to a uniform wet film thickness of 20 mils and immediately dressed with glass beads at the proper rate, shall exhibit a no-tracking drying condition in not more than 30 minutes at 72°F.

13. Dry Time - Field. The no-tracking condition for the field shall be considered as the condition where no visual displacement of the epoxy resin striping material is observed when a passenger car has passed over the stripe or handwork when viewed at a distance of 50 feet and shall be a maximum of 30 minutes at 70°F.

M.17.04.2 Certification. The manufacturer shall furnish a certified test report by an independent testing laboratory prior to the start of the work indicating that the material as specified has been tested in accordance with the above procedures and that the results comply with the above requirements. A Material Safety Data Sheet is also required.

a. Samples. At least 30 days prior to use, the manufacturer shall submit samples of the components to the Engineer for use as a baseline test batch. These samples shall be in sealed quart can containers; contain a minimum of 24 fluid ounces; contain all relevant manufacturing information; identification of proposed Rhode Island Contract numbers; infrared spectrophotometer information; and sent to:

Rhode Island Department of Transportation
Materials Section - Central Laboratory
State Office Building
2 Capitol Hill
Providence, RI 02903

b. Certified Test Reports. The manufacturer shall furnish certified test reports for each batch delivered for application at the project site. Reports shall reference batch number and physical characteristics outlined above. Application shall not commence until the proposed epoxy materials are verified by submitting this Certificate to the Engineer.

M.17.04.3 Packaging. The epoxy materials shall be shipped in appropriate, durable, and substantial containers. Individual containers shall be plainly marked with the following information: manufacturer's name and address; name of product; lot number; batch number; color; net weight and volume of contents; date of manufacture; date of expiration; statement of content (i.e., Part A - contains pigment and epoxy resin; Part B - contains catalyst); mixing proportions, application temperatures and instructions; and safety information.

SECTION M.18

LANDSCAPING MATERIALS

M.18.01 LOAM. The material to be furnished shall consist of screened loose, friable, fine sandy loam or sandy loam, as defined by the USDA's Soil Conservation Service in the Soil Survey Manual issued in 1993, free of subsoil, refuse, stumps, roots, rocks, cobbles, stones, brush, noxious weeds, litter and other materials which are larger than ½-inch in any dimension and which will prevent the formation of a suitable seed bed. Organic matter shall constitute not less than 5 percent nor more than 20 percent of the loam as determined by loss-on-ignition of oven dried samples that have been drawn by the Engineer, unless otherwise specified or directed. The loam shall have an acidity range of 5.5 pH to 7.6 pH. The Contractor shall notify the Department of the intended source of loam to be employed at least two weeks prior to the intended time of use to allow time for sampling.

M.18.02 PLANTABLE SOIL. The material to be furnished shall consist of loose, friable topsoil free of refuse, brush, stumps, roots, rocks, cobbles, stones, noxious weeds, litter, and other materials which are longer than 1 inch in any dimension and which will prevent the formation of a suitable seed bed. Organic matter shall constitute not less than 4 percent nor more than 20 percent of the plantable soil as determined by loss-on-ignition of oven dried samples that have been drawn by the Engineer, unless otherwise specified or directed. The plantable soil shall have an acidity range of approximately 5.5 pH to 7.5 pH.

The composition of plantable soil can also be arrived at by thoroughly mixing a suitable organic soil with a suitable subsoil. The resulting mix shall be a homogeneous material free from hard lumps, other materials specified above and be capable of supporting plant growth. This soil mixture must meet the above specified requirements for organic matter content and pH. The Contractor shall notify the Department of the intended source of plantable soil to be employed at least two weeks prior to the intended time of use to allow for sampling.

M.18.03 COMPOST. The material shall be a well decomposed, stable, weed free organic matter source. It shall be derived from agricultural, food, and/or yard trimmings. The product shall contain no substances toxic to plants and shall be reasonably free (less than 1 percent by dry weight) of man-made foreign matter. The compost will possess no objectionable odors and shall not resemble the raw material from which it was derived. Compost shall have a pH between 5.5 pH and 8.0 pH

and a moisture content between 35 percent and 55 percent. The particle size shall pass through a 1-inch screen or smaller. It must be stable to highly stable, pass growth screening and have a soluble salt concentration at 2.5 d s/m or less for soil blend. The compost must meet US EPA Part 503 exceptional quality concentration limits for trace elements/heavy metal.

M.18.04 HIGH ORGANIC SOIL. The material to be furnished shall consist of a soil free of refuse, brush, stumps, roots, rocks, cobbles, stones, noxious weeds, litter, and other materials which are larger than 4 inches in the greatest dimension and which will prevent the formation of suitable seed bed. Organic matter shall constitute not less than 10 percent nor more than 25 percent of the High Organic Soil as determined by loss-on-ignition of oven dried samples that have been drawn by the Engineer, unless otherwise specified or directed.

M.18.05 LIME.

M.18.05.1 Ground Lime. Ground lime for all roadside horticultural purposes shall consist of a standard commercial product of ground dolomitic limestone intended for agricultural use. It shall be fine ground dolomite such that, when "burned" by standard lime producing methods, it shall yield at least 30 percent calcium oxide and 5 percent to 20 percent magnesium oxide for a total of 50 percent yielded from calcium and magnesium oxide. At least 40 percent but not more than 60 percent should pass through a 100-mesh screen, and all shall be able to pass a 20-mesh screen.

M.18.05.2 Pelletized Lime. Pelletized lime for all roadside horticultural purposes shall consist of a standard commercial product of pelletized dolomitic limestone. The minimum calcium carbonate ($CaCO_3$) derived from magnesium sources shall be 48 percent.

Prior to pelletizing, 100 percent by weight shall pass through an 8-mesh screen, 90 percent through a 20-mesh screen, 65 percent through a 60-mesh screen and 50 percent through a 100-mesh screen.

M.18.06. FERTILIZER.

M.18.06 .1 Commercial Fertilizer.

a. General. Commercial fertilizer shall be a product complying with the State and the U.S. Fertilizer Laws. Deliver to the site in the original, unopened, standard size containers which shall show weight, analysis of the product, name of the manufacturer, and bear the manufacturer's Certificate of Compliance covering analysis.

b. Fertilizer for Seeding and Sodding. Fertilizer shall contain the following percentages by weight:

10 percent available Nitrogen (N)
10 percent available Phosphoric Acid (P)
10 percent available Potassium (K)

Significant quantities of trace elements such as iron, boron, etc. shall also be contained in the fertilizer. Fifty percent of available nitrogen shall be in a slow-release form as is found in certain urea-form products, or natural organic forms, or a combination of both. The salt index of the fertilizer shall not exceed 35.

Unless otherwise specified, fertilizer meeting these requirements shall be applied at the rates set forth in **SECTIONS L.02; SEEDING, L.03; SODDING, AND L.04; REFERTILIZATION OF SEEDED, SODDED, AND GRASSED AREAS**, of these Specifications.

M.18.06.2 Fertilizer for Trees, Shrubs, Vines, Perennials, Ornamental Grasses, Ground Covers, and Bulbs. Fertilizer shall contain the following percentages by weight:

10 percent available Nitrogen (N)
10 percent available Phosphoric Acid (P)
10 percent available Potassium (K)

Significant quantities of trace elements such as iron, boron, etc. shall also be contained in the fertilizer. Seventy-five percent of available nitrogen shall be in a slow-release form as is found in certain urea-form products or natural organic forms or a combination of both. The salt index of the fertilizer shall not exceed 35.

Unless otherwise specified fertilizer meeting these requirements shall be applied at the following rates:

Trees, Shrubs, Vines: 5 lbs. (of actual N) per 1,000 square feet.

Perennials, Ornamental Grass, Ground Covers: 2½ lbs. (of actual N) per 1,000 square feet.

Bulbs: ½ lb. (of actual N) per 1,000 square feet.

M.18.07 BONE MEAL. The material to be furnished shall consist of fine ground, steam-cooked, packing house bone with a minimum analysis of 23 percent phosphoric acid and 4 percent nitrogen.

M.18.08 MULCH.

M.18.08.1 Cellulose Fiber. Cellulose fiber mulch shall be derived from natural, clean, whole woodchips. Fiber shall not be produced from recycled material such as sawdust, paper, or cardboard fiber and shall be dyed green to contrast with the soil on which it is to be applied. Fiber shall have a water holding capacity of not less than 31.5 ounces of water per 3.5 ounces of fiber. The rate of application for cellulose fiber mulch shall be in accordance with manufacture's guidelines and approved by the Engineer.

M.18.08.2 Wood Chips. Wood chips for mulch shall be 1/8-inch nominal thickness with 75 percent of the chips having an area of not less than 1 square inch nor more than 6 square inches. Chips shall be free from leaves, twigs, shavings and bark and other foreign materials which are injurious to healthy plant growth. Wood chips shall be obtained only from green wood and may be from either hardwood or softwood sources.

M.18.08.3 Pine Bark Mulch. Pine Bark Mulch shall be derived from evergreen tree bark aged a minimum of 6 months and no more than 18 months. The bark shall be shredded so that the resulting pieces are no more than 1/4-inch thick and no longer than 3 inches. The mulch shall be free of stringy material and shall not contain an excess of fine particles. The mulch shall be dark brown in color, free of leaves, twigs, sod, weeds, shavings, and other foreign materials which are injurious to healthy plant growth.

M.18.08.4 Adhesive Mulch Stabilizer. Adhesive mulch stabilizer material shall be a powder or liquid chemical which when properly mixed, applied, and cured will create a water insoluble bio-degradable mesh. Prior to application, the manufacturer's recommendations shall be submitted for approval.

Adhesive mulch stabilizer shall be mixed according to manufacturer's directions, or as specified.

M.18.09 SEED STABILIZER MATERIALS.

M.18.09.1 Straw. Straw for mulch shall be mowings of acceptable herbaceous growth reasonably free from noxious weeds or woody stems and shall be reasonably dry. No salt hay, feed hay and/or construction hay shall be used.

M.18.09.2 Erosion Control Netting. All erosion control netting material shall be new, clean, sound, free of rips and tears and shall be furnished in lengths of not less than 50 feet.

a. Jute Mesh. Jute mesh shall be uniform, open, plain weave of undyed and unbleached, smolder resistant, natural single jute yarn, a minimum of 4 feet in width plus or minus 1 inch. There shall be 78 warp ends per width and 41 weft ends per yard. Weight shall average 1.22 pounds per linear yard, plus or minus 5 percent.

b. Excelsior Matting. The excelsior matting shall be made of a uniform web interlocking wood excelsior fiber with a backing of mulchnet fabric one side only. The mulchnet shall be woven of either twisted paper cord or cotton cord with mesh sizes not exceeding 1½-inches by 3 inches.

Excelsior matting shall be furnished in rolled strips of not over 150-foot average length and shall meet the following minimum requirements and as shown on the Plans.

Width: minimum 36 inches, plus or minus 1 inch.

Weight to average: 0.80 pound per square yard, with a tolerance of plus or minus 5 percent.

Staples shall be made from 12-inch lengths of No. 11 gauge steel wire bent to form a "U" of 1.5 to 2 inches in width. Longer staples may be required for loose soils.

M.18.09.3 Erosion Control Blanket. The blanket shall be a nonwoven, natural, biodegradable wood fiber formed into a blanket. A photodegradable polypropylene netting shall be laminated to its surface. The blanket shall not contain growth inhibiting additives and shall be free of noxious weed seeds.

The width shall be 40 inches or 80 inches, plus or minus 1 inch.

The weight shall average 0.50 pound per square yard, with a tolerance of plus or minus 10 percent.

M.18.09.4 Staples for Seed Erosion Stabilizer Materials. Staples shall be made from 11 gauge steel; shall be 6 inches long; shall be used with jute mesh, excelsior matting, and erosion control blanket.

M.18.10 SEED MIXTURES.

M.18.10.1 General. All legume seed shall be inoculated within 24 hours before mixing and planting with the appropriate inoculum for each variety. All inocula shall be fresh and shall be used within the date limit prescribed by the manufacturer. Three times the normal amount of inoculant shall be required when the seed is to be treated in an approved hydroseeder.

All seed delivered to the job shall be in containers labeled in accordance with provisions of the Rhode Island Seed Act of 1956 (Volume 8, Title 2, Chapter 6) and its amendments as provided for agricultural seed offered for sale. Only the current years seed shall be accepted.

M.18.10.2 Park Mix.

	Percent by Weight	**Percent by Volume (Pure Live Seed)**
Creeping Red Fescue Improved varieties	70	78
Kentucky Bluegrass Improved varieties	15	68
Perennial Ryegrass Improved varieties	15	85

Seeding rate: 150 lbs. per acre

M.18.10.3 Slope Mix.

	Percent by Weight	**Percent by Volume (Pure Live Seed)**
Creeping Red Fescue Improved varieties	60	85
Perennial Ryegrass Improved varieties	15	90
Birdsfoot trefoil (Lotus corniculata)	15	78*

Seeding rate: 150 lbs. per acre

* Includes up to 20% hardseed.

M.18.10.4 Residential Seed Mix.

	Percent by Weight	Percent by Volume (Pure Live Seed)
Chewings Fescue Improved varieties	30	85
Kentucky Bluegrass Improved varieties	30	90
Perennial Ryegrass Improved varieties	40	90

Seeding rate: 150 lbs. per acre

M.18.10.5 Temporary Seed Mix.

	Percent by Weight	Percent by Volume (Pure Live Seed)
Annual Ryegrass	40	85
Perennial Ryegrass	60	90

Seeding Rate: 75 lbs. per acre

M.18.10.6 Native Seed Mix.

	Percent by Weight	Percent by Volume (Pure Live Seed)
Switch Grass/(Panicum virgatum)	20	75
Little Blue Stem/ (Andropogon Scoparius)	25	75
Perennial Ryegrass	25	90
Hard Fescue	30	

Seeding Rate: 60 lbs. per acre

M.18.10.7 Wetlands Mix. The composition of a wetlands mix for a particular application will be set forth in the Contract by a Special Provision Code.

M.18.10.8 Wildflower Seed Mix.

	Percent by Weight
Yarrow /(Achillea millefolium)	10
Oxeye Daisy/ (Chrysanthemum laucanthemum)	22
Lance-Leaved Coreopsis/ (Coreopsis lanceolata)	58
Black-Eyed Susan/(Rodbeckia Lirta)	10

Seeding Rate: 8 lbs. per acre
Hard Fescue 20 lbs. per acre

M.18.11 SOD. Sod shall be live, fresh and of suitable character for the purpose intended and for the soil on which it will be placed. Sods shall be at least 2 square feet in area and shall be thick enough to contain all natural roots without mutilation. In no case will sods be permitted to be under 3/4-inch or over 1 inch thick, unless express written permission of the Engineer is procured. Sod stored longer than 36 hours will not be allowed under any circumstances.

Sod shall have a minimum of the following:

70 percent Kentucky Bluegrass, improved variety,
and 10 percent Red Fescue (Festuca rubra), improved variety.

Upon delivery to the job site, a certificate of compliance from the supplier (sod producer) stating that the sod meets the required specifications must be presented to the Engineer before any work is to commence. The certificate must also state the date which the sod was harvested.

M.18.11.1 Wooden Pegs. Pegs shall be hard wood stakes. They shall be approximately 1 inch by 2 inches by 6 inches in length. The length shall be sufficient to penetrate from top of sod to at least 2 inches into subsoil.

M.18.12 PLANT MATERIALS. All plant materials shall conform in size, grade and quality to the "AAN American Standard for Nursery Stock," as approved by the United States of America Standards Institute, in effect at the time of invitation for bids; all scientific and common plant names of the items specified shall conform with the edition of "Standardized Plant Names," as adopted by the American Joint Committee on Horticultural Nomenclature, in effect at the time of invitation for bids.

All plant material shall be nursery grown, no collected material will be accepted. All plant material shall be free from all insects pests, plant diseases, disfiguring knots, stubs, sunscald, abrasions or cuts of the bark or any other form of injury harmful to the health of the plant material

or of objectionable disfigurement. All plant material shall comply with the State and Federal law with respect to inspection for plant diseases and insect infestations.

M.18.13 PLANTING INCIDENTALS.

M.18.13.1 Stakes. Stakes for tree supports shall be of a hardwood source, free of knots, insects and fungi. Stakes shall be of uniform size and shape and shall be a minimum of 2 inches square and be of a length sufficient enough to be driven into the ground 3 feet and have an above ground stake height of 8 inches above the point of attachment of the guy webbing. The bottom of the stake shall be pointed with a taper of no less than 4 inches. The type of stakes shall be uniform throughout the job.

M.18.13.2 Guy Webbing. Guy webbing shall be a low abrasion, woven, fiber webbing with a break strength of 900 pounds or better. The width of the webbing shall be no less than 5/8-inch nor greater than 3/4-inch. The length shall be sufficient enough to be attached to the tree trunk and stake.

M.18.13.3 Burlap. Burlap shall be jute burlap in 4-foot wide strips with a weight of approximately 8 ounces per square yard. The burlap shall be sound, dry, uncontaminated, free from rips, tears, and holes.

M.18.13.4 Twine. Twine for securing burlap shall be 3-ply jute twine.

M.18.13.5 Tape. Tape for identifying guy webbing shall be bright yellow with a waterproof adhesive backing. It shall 1½-inches wide and shall be uniform throughout the job.

M.18.13.6 Antidesiccant. Antidesiccant shall be an emulsion or other material which, when mixed with water, will provide a protective film over plant surfaces (leaf) which shall reduce or retard the loss of moisture through transpiration. Antidesiccant shall be delivered in containers clearly marked with the manufacturer's name and instructions. Antidesiccant shall be mixed and applied according to the manufacturer's guidelines.

M.18.14 HERBICIDES. Herbicides shall be packaged in standard containers marked with the name of the material, the name of the manufacturer, the net quantity contained therein, and be in accordance with the provisions of the Federal and State Rules and Regulations in effect at the time of delivery to the job site.

M.18.14.1 Pre-Emergent Herbicide. Pre-emergent herbicide for application in mulch areas and for other uses shall be granular and have the active ingredient "Trifluralin 5.0%." All application rates and product use shall be in accordance with manufacturer's guidelines.

M.18.14.2 Nonselective Herbicide. Nonselective herbicide shall have the active ingredient "Glyphosate, N-(Phosphonometyl) Glycine" and be 41 percent by volume. All application rates and product use shall be in accordance with manufacturer's guidelines.

M.18.15 PLANT PROTECTION DEVICES.

M.18.15.1 General. All materials become the property of the Contractor after removal.

M.18.15.2 Tree Protection. Wood framing shall consist of nominal lumber 6 feet in length, the width and thickness shall vary from 2" x 2" to 2" x 6", depending on trunk diameter or as directed by the Engineer. Binding material shall consist of a single strand 9-gauge wire.

M.18.15.3 Shrub and Drip-Line Protection. Fencing shall consist of standard snow fencing. The Contractor shall utilize steel poles a minimum of 6 feet in length to stabilize and support the fencing.

M.18.16 WATER FOR LANDSCAPE USE. All water shall be obtained from clean, fresh water sources and shall be free from injurious chemicals and other toxic substances harmful to plant life. No water which is brackish will be permitted at any time. The Contractor shall identify, to the Engineer all sources of water at least 2 weeks prior to use. The Engineer, at his discretion, may take samples of the water at the source or from the tank at any time, and have a laboratory test the samples for chemical and saline content. The Contractor shall not use any water from any source which is disapproved by the Engineer following such tests.

M.18.17 PAVERS.

M.18.17.1 Concrete Pavers. Concrete Pavers (interlocking or brick like) shall conform to ASTM C936; "Standard Specifications for Solid Concrete Interlocking Paving Units." The average compressive strength of concrete after 28 days shall not be less than 8,000 psi. Concrete Pavers shall not have a water absorption rate greater than 5 percent when tested in accordance with ASTM C140 and shall withstand, without cracking or showing any sign of damage, freeze-thaw test in accordance with ASTM C67, Section 8, Method A, 50 cycles.

Individual materials used to manufacture concrete pavers shall conform to the following:

1. Cement - ASTM C150; Portland Cement

2. Aggregates - ASTM C33; Washed, Graded Sand, and Limestone Aggregates

3. Other Constituents - Non-fading synthetic iron oxide color pigments, integral plasticizers and densifying agents established as suitable for use in concrete.

Concrete Pavers shall have a size of 4" x 9" x 2⅜" or 4" x 9" x 3-3/16" (nominal size for interlocking pavers) and 4" x 8" x 2⅜" or 4" x 8" x 3-3/16" (nominal size for brick like pavers).

M.18.17.2 Brick Pavers. Brick Pavers shall conform to ASTM C216, Grade SW, Type FBS. The size and trueness of shape shall be governed by ASTM C216, Table VI and VIII for Type FBS. The approximate size of the Brick Paver shall be 4" x 8¼" x 2¾".

M.18.17.3 Granite Pavers. Cut Granite Pavers shall conform to ASTM C615 and shall be free of cracks, starts and seams. Cut Granite Pavers shall not have a water absorption rate greater than 4 percent when tested in accordance with ASTM C97. The density of the Cut Granite Pavers shall be 160 pounds per cubic foot and shall have a minimum compressive strength of 19,000 psi. The Modules of Rupture of the Cut Granite Paver shall be a minimum of 1,500 psi in accordance with ASTM C99.

Cut Granite Pavers shall have a nominal size of 4" x 8" x 4" or as specified on the Plans. The tolerance of face sizes shall be plus or minus 1/8-inch.

Cut Granite Pavers shall have all side and top surfaces sawn, the bottom may be sawn or split. All angles shall be square and true and equal to 90 degrees. The top surface (face) shall be flame finished or as specified on the Plans. The color shall be light gray or as specified on the Plans.

M.18.17.4 Granite Cobble Pavers. Granite Cobble Pavers shall conform to ASTM C615 and shall be free of cracks, starts and seams. Granite Cobble Pavers shall be uniform in size and shape or shall be as specified on the Plans.

M.18.18 LANDSCAPE FILTER FABRIC. The material to be furnished shall be nonbiodegradable, nonwoven, 100 percent polypropylene fabric. The color shall be black. The fabric shall conform to the following minimum specifications:

Properties	Value
Grab Tensile Strength (lbs.) ASTM D1682	110
Grab Elongation (90) ASTM D1682	65
Trapezoid Tear Strength (lbs.) ASTM D2263	50
Mullen Burst Strength (psi) ASTM D3786	250
Puncture Strength (lbs.) ASTM D751	70
Coefficient of Permeability (cm/sec)	0.10 - 0.30
Equivalent Opening Size US Std. Sieve	70 - 100

M.18.19 STONE FINE SETTING BED AND JOINTING MATERIAL. The material to be furnished shall be sharp, washed concrete sand. The material shall not contain more than 3 percent silt and shall be free from deleterious soluble salts. The gradation shall meet the requirements of the following range:

Sieve Size	Percentage Passing
3/8"	100
No. 4	95 - 100
No. 8	70 - 100
No. 18	50 - 85
No. 30	25 - 60
No. 50	10 - 30
No. 100	5 - 20
No. 200	0 - 10

INDEX

A

Additives for Portland Cement Concrete:
- Chemical 6-3; M-9
- Latex Emulsion 8-102; M-10
- Mineral 6-26; M-9
- Calcium Nitrite 6-34
- Pozzolans 6-4

Advance Warning Arrow Panel 9-44

Advertisement for Bids:
- (See "Notice to Contractors")

Aggregate Base Courses 3-1

Aggregates:
- Base and Subbase Courses 3-1
- Bituminous Pavements 4-1; M-2; M-4; M-15
- Concrete Pavement 5-1; M-4
- Portland Cement Concrete 6-1;M-2; M-4
- Select Leveling and Filler 3-4
- Special Graded for Driveways and Shoulders 3-2

Aluminum Lighting Standards T-14; M-57

Asbestos-Cement Pipe:
- Removal and Disposal of 2-5

Asphalt Cement; Performance Graded M-15

Asphalt Emulsion Tack Coat 4-23

B

Backfill:
- Pipe 7-5
- Underdrains 7-11

Brick:
- Manhole M-22
- Sewer M-22

Baled Hay Catch Basin Inlet Protection 2-46

Baled Hay Ditch Check 2-40

Baled Hay Erosion Check 2-37

Barricades 1-52

Barricades, Portable 9-42

Base Courses:
- Aggregate and Gravel Borrow 3-1
- Bituminous Concrete 4-1
- Concrete 5-1
- Cold Recycled 4-29
- Hot Recycle Option 4-31

Bearing Capacity, Piles 8-12

Bedding Material 7-2;M-2
Bedrock, Presplitting 2-14

Bituminous Concrete Pavement:
Conditioning of Existing Surfaces 4-12
Compaction 4-14
Composition of Mixture 4-1; M-14
Gradation for:
Base Course M-14
Binder Course M-14
Bridge Binder M-14
Surface Course, Class I-1 . . . . . M-14
Surface Course, Class I-2 . . . . . M-14
Hot Recycle Option 4-31
Joints 4-15
Materials:
Aggregates M-2; M-4
Asphalt Cement M-15
Mixing 4-12
Mixing Plant 4-4
Pavers 4-11
Removal by Cold Planing 9-69
Rollers 4-12
Sawing and Sealing Joints 8-122
Spreading and Finishing 4-13
Surface Tolerances 4-16
Thickness Requirements 4-16
Weather Limitations 4-16
Bituminous Curbing and Berm 9-13; M-39
Bituminous Friction Courses 4-20; M-14
Bituminous Patching Materials:
Potholes and Trenches 4-39
Bituminous Sidewalk and Driveways 9-11
Bituminous Surface Treatments:
Prime Coat 4-24; M-15
Seal Coat 4-26
Borrow, Common 2-13; M-1
Borrow, Gravel 2-13; M-1

Bridge Bearings:
Elastomeric Bearings 8-167; 8-169
Pot and Disc Bearings 8-167; 8-170
Sliding Bearings 8-167; 8-171
Bridge Curbing, Granite 8-181; M-38
Bridge Deck Joints (See Roadway Joints, Expansion and Fixed) 8-125
Bridge Deck Repair 8-116
Bridge Overlays, Latex Modified
(See Latex Modified Concrete for Bridge Overlays) 8-102
Bridge Railing, Metal 8-173
Bridge Scupper Piping 8-172
Bridge Scuppers 8-182; M-27
Bridge Signs 8-177; M-70
Bridges; Temporary 8-2
Removal of Existing 8-3
Buildings; Existing, Removal and Disposal 2-7

C

Cable, Traffic T-7; M-52
Cabinets, Traffic Signal T-23
Catch Basins (See Drainage Structures)
Catch Basins and Manholes 7-7
Cement Concrete (See Portland Cement Concrete)
Cement Concrete Pavement and Base:
Conditioning Subgrade or Base Course 5-2
Consolidation 5-5
Crack Control 5-19
Curing 5-11
Equipment 5-1
Finishing 5-5
Form Setting 5-2
Grooving 5-18
Joints 5-4
Open to Traffic 5-10
Placement of Reinforcement 5-3
Placing Concrete 5-3
Preparation of Grade 5-2
Protection of Pavement 5-10
Repairing Joints 5-15
Sealing Joints 5-9
Slip Form Method 5-10
Chain Link Fence, Pedestrian 8-175; M-36
Chain Link Fence, Conventional 9-5
Channel Excavation 2-12
Channelizing Devices, Portable 9-42

Check Dams:
Baled Hay Erosion Checks 2-37
Log and Hay Check Dams 2-40
Sand Bag Erosion Dikes 2-40
Stone Check Dams 2-40

Cleaning and Sealing Joints:
In Bituminous Pavement 4-35; 4-37
In Concrete Pavement 5-13; 5-15
Cleaning and Sweeping Pavement 9-63
Clearing and Grubbing 2-1
Clearing, Selective L-27
Cofferdams 2-25
Combination Drains 7-11
Common Borrow:
Description 2-13; M-1
Compaction; Earth Embankment 2-19
Composite Piles 8-11
Concrete; Classification of 6-2
Curing 6-21
Gradation of Aggregates M-4
Proportioning 6-6
Low Strength 6-28
High Performance 6-32
Concrete; Bridge Deck Repair 8-116
Concrete Bridge Decks, Placement 8-94
Concrete Bridge Deck Overlays 8-106
Concrete Curbing 9-12; M-39
Concrete Filled Shell Piles 8-8; M-34
Concrete Masonry, Cast-in-Place 8-55
Curing 8-65
Finishes 8-66
Forms 8-57
Joints 8-62
Materials M-6
Placing Concrete (Conventional) 8-58
Placing Concrete (Pumping) 8-61
Repairs to 8-110
Concrete Masonry, Precast/Prestressed 8-69
Curing 8-75
Drawings 8-69
Equipment Checks 8-72
Finishing and Curing 8-75
Forms 8-72
Handling and Placing Concrete 8-75
Handling Units 8-77
Inspection of Plant 8-72

Concrete Masonry, Precast/Prestressed (continued):
Materials 8-71; M-6
Reinforcement 8-73
Tensioning 8-73
Testing 8-76
Concrete Piles; Precast/Prestressed 8-7; M-34
Concrete Sidewalks 9-9
Concrete Surface Protective Coating 8-120
Conduit, Electrical T-11; M-55
Construction:
Accesses 2-50
Embankments 2-16
Layout 9-66

Construction Signs, Temporary 9-40

Controllers, Traffic Signal T-23
Critical Path Method 1-58
Culverts 7-1
Culverts, Removal of 2-2
Curbing for Bridges:
Granite 8-181; M-40

Curbing for Roadways 9-12
Bituminous 9-13; M-39
Bituminous Berm 9-13; M-15
Granite 9-13; M-38
Precast Concrete 9-13; M-39
Reset 9-15
Cutting and Matching Pavement 9-65

D

Damage Claims 1-55
Dampproofing 8-88
Delineators, Traffic T-37
Demolition of Buildings and Structures 2-2
Dense Graded Bituminous Concrete Pavement 4-1
Department:
Definition of 1-4
Detectors and Relays, Traffic T-24; M-54
Dewatering Basins, Temporary 2-43
Differing Site Conditions 1-24
Directional Signs T-29; M-86
Ground Mounted Primary T-33; M-86

Dowels, Drill and Grout 8-119
Drainage Pipe (See Storm Drains)
Drainage Structures; Manholes, Catch Basins and Inlets:
Adjust to Grade 7-16
Cut-Ins 7-20
Frames, Grates and Covers M-22
Masonry Unit Construction 7-8; M-22
Precast Concrete Construction 7-9
Reconstruct Manholes and Catch Basins 7-13
Removal of 2-2
Driven Piles 8-4
Driveways, Bituminous 9-9
Driving Equipment; Piles 8-16
Drum Barricades 9-42
Dust Control 9-18

E

Elastomeric Bearings, Bridge 8-167; 8-169
Electrical Work T-1
Embankment Construction 2-11; 2-13
Compaction 2-19

Energy Absorbing Assemblies:
Remove and Reset 9-33

Erosion and Pollution Controls:
Perimeter Controls 2-37
Check Dams 2-40
Dewatering Basins 2-43
Storm Drain Protection 2-46
Stilling Basins 2-49
Cleaning and Maintenance of 2-51
Excavation:
Description, Various Types 2-11

Extended Establishment Period L-22
Extra Work 1-25

F

Fences, Chain Link 9-5
Braces and Gates 9-6
Installing Posts and Fabric 9-5
Materials M-36
Fences, Remove and Reset 9-7
Field Control for Construction Layout 9-66
Field Office 9-52
Filter Fabric Retention Basin 2-44
Filter Stone M-4

Flagpersons 9-31
Flagstones 9-19
Flashings 8-86
Fluorescent Traffic Cones 9-42

Foundation Piles 8-4
Friction Courses 4-20

G

Gas Gate Boxes 7-23
Grading; Trimming and Fine 2-29
Granite Curbing:
Bridges 8-181; M-40
Roadways 9-13; M-38

Granite Identification Tablets 8-179
Grassed Areas, Refertilization of L-11
Gravel Base Courses 3-1
Gravel Borrow:
Description 3-1; M-1
Gravel Borrow Subbase Courses 3-2
Grooving Concrete Pavement 5-18
Ground Mounted Primary Directional Signs T-33; M-70
Ground Rods and Ground Wire T-6
Guardrail (See Steel Beam Guardrail) 9-1

H

Handholes T-9; M-55
Hazard Markers, Traffic T-37
Hazardous Material 1-57
Health Provisions 1-51
Herbicides L-34; M-104
High Organic Soil L-1; M-98
Highway Bounds 9-32; M-43
Highway Lighting T-5
Hydrants; Remove and Relocate 7-25
Hydrodemolition; Containment of Runoff 2-56

I

Identification Tablets, Granite 8-179
Inlets, Curb (See "Drainage Structures")
Inspection of Plants 1-45
Inspection of the Work 1-35
Isolated Trees and Stumps:
Cutting and Removal 2-1
Partial Removal of 2-1
Insurances 1-56

J

Joint Seal, Silicone 8-124
Joints in Bituminous Pavements:
Construction of 4-15
Sealing 4-37
Joints in Concrete Pavement:
Cleaning and Sealing 5-13; 5-15
Construction of 5-4
Repairing 5-15

K

Keystone M-4

L

Laboratory:
Materials 9-52
Plant Field 9-58
Latex Modified Concrete for Bridge Overlays 8-102
Batching and Mixing 8-103
Materials:
Concrete M-6
Latex Emulsion Modified M-10
Mixture Design 8-103
Placing, Finishing, Curing, and Grooving 8-105

Lighting:
Highway Lighting T-5
For Night Work Operations T-49
Lighting Standards and Foundations T-14; M-57
Liquidated Damages 1-65
Load Restrictions 1-36
Loam L-1; M-97
Loam Excavation 2-12
Log and Hay Check Dams 2-41
Low Strength Concrete 6-28
Luminaires T-13; M-56

M

Maintenance and Cleaning of
Erosion and Pollution Controls 2-51
Maintenance and Movement of Traffic Protection Devices 9-71
. . . . . .
Manholes and Catch Basins (See Drainage Structures)

Materials Laboratory 9-52
Median Barrier, Precast Concrete: 9-20
For Temporary Traffic Control 9-47
Message Sign, Portable and Changeable 9-45
Metal Bridge Railing 8-173
Metal Frames and Covers; Removal of 2-2
Metal Grates, Removal of 2-2
Milepost Markers T-39; M-70
Mobilization 9-70
Muck Excavation 2-12

N

O

Overhead Sign Panels and Supports T-36; M-70; M-84

P

Painting Structural Steel 8-152
Materials M-31
Painting Existing Steel 8-159
Painting New Steel Structures 8-154
Personnel and Environmental Protection 8-161
. . . . . .
Paved Waterways 7-21
Pavers 4-11
Pavement:
Bituminous 4-1
Cement Concrete 5-1
Cleaning and Sweeping 9-63
Cutting and Matching 9-65
Saw Cutting for Installation of Traffic Count Loop Detectors 9-66
Pavement Marker; Raised Reflective 9-23
Pavement Markings T-39; M-89
Bi-Directional Control Devices T-47
Thermoplastic Markings T-41; M-92
Waterborne Markings T-40; M-90
Paving, Tree Cut-Outs L-31; M-105

Pedestrian Chain Line Fence 8-175; M-36
Piles:
Bearing Capacity 8-12
Composite Piles 8-11
Concrete Filled Shell Piles 8-8; M-34
Cut-offs 8-24
Defective 8-24
Driving 8-21
Driving Equipment 8-16
Load Tests 8-22
Precast/Prestressed Concrete Piles 8-7; M-34
Preparation for Driving 8-19
Splicing 8-11
Steel H-Piles 8-10; M-35
Steel Pipe Piles 8-9; M-35
Timber Piles 8-7; M-34
Wave Equation Analysis 8-12
Pipe:
Bedding 7-2
Bituminous Coated M-21
Clean and Flush 7-17
Joining 7-3
Laying 7-3
Metal 7-1; M-20
Non-metallic 7-1; M-18
Perforated M-21
Plug and Cap 7-15
Underdrains 7-11; M-19
Placement of Concrete Bridge Decks 8-94

Plant Field Laboratory 9-58

Plantable Soil L-1; M-97
Planting L-15; M-104
Plastic Pipe Barricades 9-42
Polyethylene Drum Barricades 9-42

Portable Changeable Message Sign 9-45
Portable Channelizing Devices and Barricades 9-42
Portland Cement Concrete:
Aggregates 6-5; M-2; M-4
Batching Plant and Equipment 6-8
Chemical Admixtures 6-3; M-9
Classification 6-2
Cold and Hot Weather Concrete 6-15; 6-16
Curing 6-21
Low Strength 6-28
Materials M-6
Mineral Admixtures 6-26; M-9
Mixing, Delivery and Discharge 6-11
Placement by Pumping 6-24
Proportioning 6-6
Testing 6-17
Thrust Blocks, Headwalls, etc. 7-19
Water 6-6
Portland Cement Concrete and Base
(See Cement Concrete Pavement and Base) 5-1
Postmaster Approved Rural Mail Boxes 9-35
Pot and Disc Bridge Bearings 8-167; 8-170
Potholes; Temporary Patching 4-39
Precast Concrete Median Barrier 9-20
For Temporary Traffic Control 9-47
Remove and Relocate 9-49
Price Adjustments:
Diesel Fuel 9-74
Liquid Asphalt 9-73
Prime Coat; Bituminous 4-24; M-15

Protective Coating, Concrete Surfaces 8-120

Pull Boxes T-9; M-55

Q

R

Raised Reflective Pavement Marker 9-23
Regulatory Signs T-29; M-86
Reinforcing Steel 8-79
Bar Schedules 8-80
Fabrication and Delivery 8-80
Materials M-23
Placing and Fastening 8-91
Removal and Disposal of:
Asbestos Cement Pipe 2-2
Culverts, Drainage Structures 2-2
Curbing, Storage Tanks; Fences 2-2
Metal Frames, Covers or Grates 2-2
Pipe, Pavements, Sidewalks 2-2
Railing and Guardrail 2-2
Trees and Stumps 2-2
Removal of Existing Bridge 8-3
Removing Bituminous Pavement by Cold Planing 9-69

Retention Basin 2-49

Riprap 9-37
Roadway Joints, Expansion and Fixed 8-125
Asphaltic Bridge Deck Joint 8-128
Compression Type Neoprene Deck Joint 8-127
Strip Seal Expansion Joint 8-128
Rock Excavation 2-12
Root Pruning; Tree and Shrub L-28

Rural Mail Boxes:
Postmaster Approved 9-35
Remove and Replace 9-34

S

Sand Bag Erosion Dikes 2-40

Saw Cutting of Pavements for Installation of Traffic Count Loop Detectors 9-66
Sawing and Sealing Joints in Bituminous Concrete Pavement 8-122

Scupper Piping, Bridge 8-172
Scuppers 8-182; M-27
Seal Coat; Bituminous 4-26; M-15
Sealing Joints and Cracks:
In Bituminous Pavements 4-35; 4-37
In Concrete Pavements 5-13; 5-15
Seed Stabilizers L-12; M-100
Seeded and Sodded Areas, Refertilization of L-11; M-99
Seeding L-4; M-101
Selective Clearing L-27
Service Pedestal T-17; M-59
Shear Connectors 8-132; 8-148; M-26
Sheet Piling; Temporary and Permanent 8-28
Concrete Sheet Piling, Precast M-34
Driving 8-31
Steel Sheeting M-33
Timber Sheeting M-34
Shell Piles 8-8; M-34
Shop Drawings 1-30
Shotcrete, Repairs to Concrete 8-112
Shrub Protection Device L-29
Shrub Root Pruning L-28
Shrub Trimming L-26
Sidewalks:
Bituminous Sidewalks and Driveways 9-11
Concrete Sidewalks and Driveways 9-10
Signal Heads, Traffic T-27; M-67
Sign Panels and Supports, Overhead T-36;M-70; M-84
Signs; Directional, Regulatory, and Warning T-29; M-70
Silicone Highway Joint Seal 8-124

Silt Fence 2-37
Site Preparation 2-1
Sliding Bridge Bearings 8-167; 8-171
Slope Paving 9-39
Sodding L-8; M-103
Soil, Plantable L-1; M-97
Soldier Pile-and-Lagging 8-28
Driving 8-31
Steel Piles M-35
Timber Lagging M-44
Timber Piles M-34
Splicing Piles 8-11
Standards and Posts, Traffic Signal T-21
Steel Beam Guardrail 9-1
Installation 9-1
Materials M-36
Reflectorized Delineators 9-2
Steel H-Piles 8-10; M-35
Steel Pipe Piles 8-9; M-35
Steel, Reinforcing (See Reinforcing Steel) 8-79
Stilling Basins 2-49
Stone Check Dams 2-40
Stone Masonry 8-43; M-50
Stone Masonry Walls 9-26
Stone Walls; Remove and Rebuild 9-28
Stone Walls, Historic 9-74
Storm Drain Protection:
Baled Hay Catch Basin Inlet Protection 2-46
Sand Bag Gutter Inlet Barrier 2-46
Silt Fence Catch Basin Inlet Protection 2-46
Storm Drains:
Bedding Materials 7-2; M-2
Laying and Joining Pipe 7-3
Metallic Pipe 7-1; M-20
Non-Metallic Pipe 7-1; M-18
Pipe; Clean and Flush 7-17
Pipe; Plug and Cap 7-15
Structural Steel Construction 8-131; M-24
Blast Cleaning of Surfaces 8-159
Personnel and Environmental Protection 8-161
Bolted Connections 8-147
Erection 8-146
Fabrication 8-134
Painting 8-152
Testing 8-133
Weathering Steel 8-148
Welding 8-140
Zinc Coating, Thermal Sprayed 8-164

Structure Concrete Masonry, Cast-in-Place 8-55
(See Concrete Masonry, Cast-in-Place)
Structure Concrete Masonry, Precast/Prestressed 8-69
(See Concrete Masonry, Precast/Prestressed)
Structure Excavations:
Backfilling 2-26
Description; all types 2-23
Subbase Courses 3-2
Gravel Borrow 3-2
Subdrains (See Underdrains) 7-11
Surface Courses:
Bituminous Class I-1 and I-2 4-1
Bituminous; Dense Friction 4-20
Bituminous; Ramp Friction 4-20

T

Tack Coat; Asphalt Emulsion 4-23

Temporary Construction Signs 9-40
Temporary Dewatering Basins 2-43
Test Pits 9-36
Thermoplastic Pavement Markings T-41; M-92
Timber Construction 8-37; M-44
Timber Guardrail, Steel Backed 9-3; M-36
Timber Piles 8-7; M-34

Traffic Protective Devices; Maintenance and Movement 9-71
Traffic Signal Systems T-18
Detector Relays T-24; M-67
Signal Controllers and Cabinets T-23
Signal Heads T-27; M-67
Signal Standards and Posts T-21
Trafficpersons 9-30
Tree Cut-Out Paving L-31; M-105
Tree Protection Device L-29
Tree Root Pruning L-28
Tree Trimming L-26
Tree Wells and Tree Walls L-33; M-50
Trees and Stumps:
Cutting and Removal of 2-1
Partial Removal of 2-1
Temporary Bridges 8-2

Trench Excavation:
Backfill and Compaction 2-34
Description, all types 2-32
Dewatering 2-34
Excavation 2-32
Protection 2-33
Trenches; Temporary Patching 4-39
Trestle Piles 8-5
Trimming and Fine Grading 2-29
Truck Mounted Attenuator with
Truck Mounted Flashing Arrow Board 9-50

U

Unclassified Excavation 2-12
Underdrains:
Filter Stone and Bedding 7-11; M-2
Pipe 7-11; M-19
Utilities
Cooperation with 1-32
Utility Structures:
Water and Gas Gate Boxes 7-23

V

Vibrators:
Concrete Pavement 5-6
Concrete Structure 8-59

W

Walls, Stone Masonry 9-26
Warning Signs, Traffic T-29; M-86
Water Gate Boxes 7-23
Waterborne Pavement Markings T-40; M-90
Waterproofing 8-88
Waterstops 8-86
Wave Equation Analysis 8-12
Wire, Traffic T-7; M-52

X, Y, Z

Zinc Coating, Thermal Sprayed 8-164; M-30