

DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA

VOID FOR BIDDING

PROPOSAL

DO NOT UNSTAPLE THIS BOOKLET....ENTER ALL REQUIRED INFORMATION
----- EITHER BY HAND OR BY STAMP.

DATE OF OPENING : April 20, 2012

CALL ORDER : 025

CONTRACT ID : B34313-12-000-0

PCN	PROJECTS AND CONTRACT NO.
-----	-----
0010290.01000	0010290
0010311.01000	0010311

COUNTY : FORSYTH

FULTON

CODE _____ ISSUED TO:

1. _____
2. _____
3. _____

PART 1 OF 2

THE CONTRACTOR SHALL RETURN ALL PARTS OF THE PROPOSAL
WITH HIS BID UNLESS BIDDING ELECTRONICALLY

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA**

DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA

CONTRACT ID : B34313-12-000-0
DESIGN BUILD PROJECT CONSISTING OF 2.962 MILES OF
CONSTRUCTION OF A LANE EXTENTION ON US 19/SR 400
BEGINNING AT MCFARLAND RD (CR 458) AND EXTENDING TO BIG
CREEK GREENWAY NB LANE EXTENTION; ALSO INCLUDES CONSTRUCTION
OF ABERNATHY RD NB RAMP EXTENTION.

PROPOSAL GUARANTY : 5%

SITE	COMPLETION DATE	CONTRACT TIME	LIQUIDATED DAMAGES
00	01/31/13	COMPLETION DATE	
COMPLETE CONTRACT			
01		AVAILABLE DAYS	
FAIL TO REOPEN TRAVEL LANES - SEE SPEC PROV SEC 108			
02		AVAILABLE DAYS	
FAIL TO ADHERE TO HOLIDAY RESTRICTIONS-SEE SPEC PROV SEC 108			
03		AVAILABLE DAYS	
FAIL TO ADHERE TO OUTAGE RESTRICTIONS-SEE SPEC PROV SEC 108			

NOTICE TO BIDDERS

If a DBE goal is specified, the bidder shall submit with this bid proposal a list of all proposed DBE participants. A form for this purpose is provided in this proposal. Please refer to the following specifications:

102.07 Rejection of Proposals
Disadvantaged Business Enterprise Program (Special Provision)

BIDDERS SHALL ENTER ALL UNIT PRICES, MAKE ALL EXTENSIONS AND TOTAL THE BID.

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA**

DEPARTMENT OF TRANSPORTATION
 STATE OF GEORGIA
 SCHEDULE OF ITEMS

PAGE: 1
 DATE: 03/21/12

CONTRACT ID: B34313-12-000-0
 PROJECT(S) : 0010290.01000 0010290
 0010311.01000 0010311

LINE NO	ITEM DESCRIPTION	APPROX. QUANTITY AND UNITS	UNIT PRICE		BID AMOUNT	
			DOLLARS	CTS	DOLLARS	CTS
SECTION 0001 ROADWAY						
0005	150-9011 TRAFFIC CONTROL - WORKZONE LAW ENFORCEMENT (CONTRACTOR BIDS)	500.000 HR				
0010	999-2010 DESIGN COMPLETE 0010290	LUMP	LUMP			
0015	999-2010 DESIGN COMPLETE 0010311	LUMP	LUMP			
0020	999-2015 CONSTRUCTION COMPLETE 0010290	LUMP	LUMP			
0025	999-2015 CONSTRUCTION COMPLETE 0010311	LUMP	LUMP			
	SECTION 0001 TOTAL					
	TOTAL BID					

**DEPARTMENT OF TRANSPORTATION
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STATE OF GEORGIA DEPARTMENT OF TRANSPORTATION
CONSTRUCTION CONTRACTORS
BID OPPORTUNITY LIST

FORM EEOB
PREQUALIFICATION OFFICE
Revised 05/16/11

Please complete and mail or FAX to:
Construction Bidding Administration
600 West Peachtree Street, NW
Suite 1113
Atlanta, Georgia 30308
TELEPHONE: (404) 631-1147
FAX: (404) 631-1275

This information shall be submitted in accordance with Specification Section 102.18

Prime Contractor/Consultant: _____
Address/Telephone Number: _____
Bid/Proposal Number: _____
Quote Submitted MM/YY: _____

49 CRF Part 26.11 requires the Georgia Department of Transportation to develop and maintain a "bid opportunity list". The list is intended to be a listing of all firms participating or attempting to participate, on DOT assisted contracts. The list must include all firms that bid on prime contracts, or bid or quote subcontracts and materials supplies on DOT-assisted projects, including both DBEs and non-DBEs. For consulting companies this list must include all subconsultants contacting you and expressing an interest in teaming with you on a specific DOT assisted project. Prime contractors and consultants must provide information for Nos. 1, 2, 3, and 4 and must provide information they have available on Numbers 5, 5.A.6, 7, 8 and 9 for themselves, and their subcontractors and subconsultants.

1. Federal Tax ID Number: _____
2. Firm Name: _____
3. Phone: _____
4. Address: _____

6. DBE
 Non-DBE
7. Subcontractor
8. Subconsultant
9. Supplier

5. Contact _____
5.A. Company E mail address _____

-
1. Federal Tax ID Number: _____
2. Firm Name: _____
3. Phone: _____
4. Address: _____

6. DBE
 Non-DBE
7. Subcontractor
8. Subconsultant
9. Supplier

5. Contact _____
5.A. Company E mail address _____

-
1. Federal Tax ID Number: _____
2. Firm Name: _____
3. Phone: _____
4. Address: _____

6. DBE
 Non-DBE
7. Subcontractor
8. Subconsultant
9. Supplier

5. contact _____
5.A. Company E mail address _____

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA**

GEORGIA SECURITY AND IMMIGRATION COMPLIANCE ACT AFFIDAVIT

Contractor(s) Name: _____

Letting: _____

Call No: _____

By executing this affidavit, the undersigned person or entity verifies its compliance with O.C.G.A. § 13-10-91, stating affirmatively that the individual, firm, or corporation which is contracting with the Georgia Department of Transportation has registered with, is authorized to participate in, and is participating in the federal work authorization program commonly known as E-Verify,* in accordance with the applicable provisions and deadlines established in O.C.G.A. § 13-10-91.

The undersigned person or entity further agrees that it will continue to use the federal work authorization program throughout the contract period, and it will contract for the physical performance of services in satisfaction of such contract only with subcontractors who present an affidavit to the undersigned with the information required by O.C.G.A. § 13-10-91(b).

The undersigned person or entity further agrees to maintain records of such compliance and provide a copy of each such verification to the Georgia Department of Transportation at the time the subcontractor(s) is retained to perform such service.

EEV / E-Verify™ User Identification Number

Date of Authorization

BY: Authorized Officer or Agent
(Name of Person or Entity)

Date

Title of Authorized Officer or Agent

Printed Name of Authorized Officer or Agent

SUBSCRIBED AND SWORN
BEFORE ME ON THIS THE

____ DAY OF _____, 201__

[NOTARY SEAL]

Notary Public

My Commission Expires: _____

* or any subsequent replacement operated by the United States Department of Homeland Security or any equivalent federal work authorization program operated by the United States Department of Homeland Security to verify information of newly hired employees, pursuant to the Immigration Reform and Control Act of 1986 (IRCA), P.L. 99-603

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA**

REQUEST FOR ELIGIBILITY TO BID

GEORGIA DEPARTMENT OF TRANSPORTATION
OFFICE OF CONSTRUCTION BIDDING ADMINISTRATION
600 West Peachtree St., N.W.
Atlanta, GA 30308

Email contacts: jismail@dot.ga.gov
anstewart@dot.ga.gov

GDOT NUMBERS: (404)631-1070 Sales Office Fax
(404)631-1275 Sales Office Alternate Fax
(404)631-1945 Main Office CBA Fax

LETTING DATE:

GDOT
VENDOR CODE:

COMPANY NAME:

CONTACT PERSON:

EMAIL ADDRESS:

*FOR OPTIMUM SERVICE, KEEP GDOT UP-TO-DATE
WITH YOUR CONTACT INFORMATION*

(Mailing Address, Phone No., Fax No., E-mail Address, Primary Contact Person, etc.

Indicate below the three digits of the Call Order Number, and your bidding status

B = Bidding Prime

(Example: 1.) 001 B 2.) 006 B 3.) 018 B etc.)

1.	<input type="text"/>	5.	<input type="text"/>	9.	<input type="text"/>	13.	<input type="text"/>
2.	<input type="text"/>	6.	<input type="text"/>	10.	<input type="text"/>	14.	<input type="text"/>
3.	<input type="text"/>	7.	<input type="text"/>	11.	<input type="text"/>	15.	<input type="text"/>
4.	<input type="text"/>	8.	<input type="text"/>	12.	<input type="text"/>	16.	<input type="text"/>

Complete this form to Request For Eligibility To Bid. The deadline to submit this form to GDOT, Office of Construction Bidding Administration is no later than 12:00 p.m. on the day preceding the letting. **** Failure to submit this document will result in ineligibility to bid.**

**DEPARTMENT OF TRANSPORTATION
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CERTIFICATIONS

(English Project)

Revised: April 20, 2011

Revised: July 31, 2002

First Use Date 2001 Specifications: November 1, 2002

Failure to complete appropriate certification requirements identified below or submission of a false certification shall render the bid non-responsive.

EXAMINATION OF PLANS AND SPECIFICATIONS

I acknowledge that this Project will be constructed in English units.

I certify that I have carefully examined the Plans for this Project and the Standard Specifications 2001 Edition, the 2008 Supplemental Specification Book, Supplemental Specifications and Special Provisions included in and made a part of this Proposal, and have also personally examined the site of the work. On the basis of the said Specifications and Plans, I propose to furnish all necessary machinery, tools, apparatus and other means of construction, and do all the work and furnish all the materials in the manner specified.

I understand the quantities mentioned are approximate only and are subject to either increase or decrease and hereby propose to perform any increased or decreased quantities of work or extra work on the basis provided for in the Specifications.

I also hereby agree that the State, or the Department of Transportation, would suffer damages in a sum equal to at least the amount of the enclosed Proposal Guaranty, in the event my Proposal should be accepted and a Contract tendered me thereunder and I should refuse to execute same and furnish bond as herein required, in consideration of which I hereby agree that, in the event of such failure on my part to execute said Contract and furnish bond within fifteen (15) days after the date of the letter transmitting the Contract to me, the amount of said Proposal Guaranty shall be and is hereby, forfeited to the State, or the Department of Transportation, as liquidated damages as the result of such failure on my part.

I further propose to execute the Contract agreement described in the Specifications as soon as the work is awarded to me, and to begin and complete the work within the time limit provided. I also propose to furnish a Contract Bond, approved by the State Transportation Board, as required by the laws of the State of Georgia. This bond shall not only serve to guarantee the completion of the work on my part, but also to guarantee the excellence of both workmanship and materials until the work is finally accepted, as well as to fully comply with all the laws of the State of Georgia.

CONFLICT OF INTEREST

By signing and submitting this Contract I hereby certify that employees of this company or employees of any company supplying material or subcontracting to do work on this Contract will not engage in business ventures with employees of the Georgia Department of Transportation (GA D.O.T.) nor shall they provide gifts, gratuities, favors, entertainment, loans or other items of value to employees of this Department.

Also, by signing and submitting this Contract, I hereby certify that I will notify the Georgia Department of Transportation through its District Engineer of any business ventures entered into between employees of this company or employees of any company supplying material or subcontracting to do work on this Contract with a family member of GA D.O.T. employees.

**DEPARTMENT OF TRANSPORTATION
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DRUG FREE WORKPLACE

The undersigned certifies that the provisions of Code Sections 50-24-1 through 50-24-6 of the Official Code of Georgia Annotated, relating to the "Drug-free Workplace Act", have been complied with in full. The undersigned further certifies that:

1. A drug-free workplace will be provided for the Contractors employees during the performance of the Contract; and
2. Each Contractor who hires a Subcontractor to work in a drug-free workplace shall secure from that Subcontractor the following written certification:

"As part of the subcontracting agreement with (Contractors name), (Subcontractors name) certifies to the Contractor that a drug free workplace will be provided to and for the subcontractors employees during the performance of this Contract pursuant to paragraph (7) of subsection of Code Section 50-24-3."

Also, the undersigned further certifies that he will not engage in the unlawful manufacture, sale distribution, dispensation, possession, or use of a controlled substance or marijuana during the performance of the Contract.

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA**

NON-COLLUSION CERTIFICATION

I hereby certify that I have not, nor has any member of the firm(s) or corporation(s), either directly or indirectly entered into any agreement, participated in any collusion, nor otherwise taken any action in restraint of free competitive bidding in connection with this submitted bid.

It is understood and agreed that this Proposal is one of several competitive bids made to the Department of Transportation, and in consideration of mutual agreements of the bidders, similar hereto, and in consideration of the sum of One Dollar cash in hand paid, receipt whereof is hereby acknowledged, the undersigned agrees that this Proposal shall be an option, which is hereby given by the undersigned to the Department of Transportation to accept or reject this Proposal at any time within thirty (30) calendar days from the date on which this sealed proposal is opened and read, unless a longer period is specified in the Proposal or the successful bidder agrees in writing to a longer period of time for the award, and in consideration of the premises, it is expressly covenanted and agreed that this Proposal is not subject to withdrawal by the Proposer or Bidder, during the term of said option.

I hereby acknowledge receipt of the following checked amendments of the Proposal, Plans, Specifications and/or other documents pertaining to the Contract.

Amendment Nos.: 1___2___3___4___5___. I understand that failure to confirm the receipt of amendments is cause for rejection of bids.

Witness my hand and seal this the ___ day of _____, 20_____.

The bidder(s) whose signature(s) appear on this document, having personally appeared before me, and being duly sworn, deposes and says that the above statements are true and correct.

Sworn to and subscribed before me this _____
Day of _____, 20_____.

(Notary Public)

My Commission expires the _____ day of _____, 20_____.

(Federal ID No./IRS No.)

(Print Company Name)
By _____ (Seal)
Corporate President/Vice President or
Individual Owner or Partner (Strike
through all except the one which applies.)

Joint Bidder:

(Print Company Name)
By _____ (Seal)
Corporate President/Vice President or
Individual Owner or Partner (Strike
through all except the one which applies.)

Joint Bidder:

(Print Company Name)
By _____ (Seal)
Corporate President/Vice President or
or Individual Owner or Partner (Strike
through all except the one which applies.)

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA**

Call Order Number: 025

PROPOSAL INDEX

Counties: Forsyth Fulton

Project No(s): 0010290
0010311

Listed below are modifications and additions to the 2001 State of Georgia Standard Specifications Constructions of Transportation System and the 2008 Supplemental Specifications modifying the 2001 Standard Specifications.

Bid Opportunity List
Prime Contractors Work Authorization Certification
Request For Eligibility to Bid
Certification/Drug Free Workplace
Signature Page
Proposal Index
Prompt Payment
Utility Conflicts
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Sec. 104 - Scope of Work
Sec. 107 - Legal Regulation and Responsibility to the Public
Sec. 108 - Prosecution and Progress(2)
Sec. 109 - Measurement and Payment (2)
Sec. 149 - Construction Layout
Sec. 150 - Traffic Control
Sec. 153 - Field Engineers Office
Sec. 161 - Control of Soil Erosion and Sedimentation
Sec. 163 - Miscellaneous Erosion Control
Sec. 165 - Maintenance of Temporary Erosion and Sedimentation Control Devices
Sec. 167 - Water Quality Monitoring
Sec. 170 - Silt Retention Barrier
Sec. 171 - Silt Fence
Sec. 207 - Excavation and Backfill for Minor Structures
Sec. 208 - Embankments
Sec. 400 - Hot Mix Asphaltic Concrete Construction
Sec. 402 - Hot Mix Recycled Asphaltic Concrete
Sec. 412 - Bituminous Prime
Sec. 413 - Bituminous Tack Coat
Sec. 424 - Bituminous Surface Treatment
Sec. 445 - Waterproofing Pavement Joints and Cracks
Sec. 446 - Placement of Pavement Reinforcement Fabric
Sec. 456 - Indentation Rumble Strips
Sec. 500 - Concrete Structures
Sec. 550 - Storm Drain Pipe, Pipe-Arch Culverts and Side Drain Pipe
Sec. 572 - Slope Underdrains
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Sec. 624 - Sound Barriers
Sec. 627 - Mechanically Stabilized Embankment Retaining Wall
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Sec. 636 - Highway Signs
Sec. 639 - Strain Poles for Overhead Sign and Signal Assemblies
Sec. 647 - Traffic Signal Installation
Sec. 648 - Traffic Impact Attenuator
Sec. 652 - Painting Traffic Stripe
Sec. 653 - Thermoplastic Traffic Stripe
Sec. 657 - Wet Reflective Preformed Pavement Markings
Sec. 658 - Polyurea Traffic Stripe
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Sec. 702 - Vine, Shrubs, And Tree Planting
Sec. 814 - Soil Base Materials
Sec. 820 - Asphalt Cement
Sec. 824 - Cationic Asphalt Emulsion
Sec. 831 - Admixtures

Sec. 832 - Curing Agents
Sec. 833 - Joint Fillers and Sealers
Sec. 845 - Smoother Lined Corrugated Polyethylene (PE) Culvert Pipe
Sec. 853 - Reinforcement and Tensioning Steel
Sec. 863 - Preservative Treatment of Timber Products
Sec. 881 - Fabrics
Sec. 891 - Fertilizers
Sec. 894 - Fencing
Sec. 895 - Polyacrylamide (Pam)
Sec. 913 - Reflectorizing Material
Sec. 917 - Reflectors and Non Reflective Characters
Sec. 919 - Raised Pavement Markers
Sec. 925 - Traffic Signal Equipment
Sec. 934 - Rapid Setting Patching Materials for Portland Cement Concrete

Construction Activity Schedule
Sec. 103 - Award and Execution of Contract (50 Day Clause)
Sec. 105 - Control of Work(2)
Sec. 108 - Prosecution and Progress (Failure or Delay in Completing Work on Time)
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Sec. 935 - Fiber Optic System
Sec - 936 - Closed Circuit Television (CCTV)
Sec - 937 - Video Detection System
Sec - 939 - Communication and Electronic Equipment
Sec - 940 - Navigator Advanced Transportation Management System Integration
Sec. 999 - Design Build

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First Use 2001 Specifications: November 01, 2002
Revised: November 19, 2006

SPECIAL PROVISION

PROMPT PAYMENT:

Prime Contractors, who sublet a portion of their work, shall pay their subcontractors for satisfactory performance of their contracts no later than 10 calendar days from receipt of each payment made to them.

Any delay or postponement of payment among the parties may take place only for good cause with prior written approval from the Department.

If the contractor is found to be in noncompliance with these provisions, it shall constitute a breach of contract and further payments for any work performed may be withheld until corrective action is taken. If corrective action is not taken, it may result in termination of the contract.

All subcontract agreements shall contain this requirement.

First Use Date: January 1, 2007

Revised: March 26, 2008

March 5, 2009

September 30, 2009

**DEPARTMENT OF TRANSPORTATION
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SPECIAL PROVISION

Utility Conflicts

Utility companies having known facilities that conflict with the construction of this project will be directed by the Department to adjust or relocate their facilities and will be notified of the contract award.

Conform to all the requirements of the Specifications as they relate to cooperation with utility owners and the protection of utility installations that exist on the project. Refer to the requirements of Section 107, Legal Regulations and Responsibility to the Public, with particular attention to Subsection 107.21.

Coordinate The Work with any work to be performed by others in any right of way clearance and arrange a schedule of operations that will allow for completion of the Project within the specified contract time. Where stage construction is required, notify the utility owner when each stage of work is completed and the site is available for utility work to proceed.

Information concerning utility facilities known to exist within the project limits, including the list of owners, is available for reference.

Under Georgia Code Section 32-6-171, utilities are required to remove or relocate their facilities. The Department is required to give the utility at least 60 days written notice directing the removal, relocation, or adjustment and the utility owner is required to begin work within the time specified in the utility's work plan or revised work plan.

Upon request, copies of all agreements with utility companies having facilities on this project will be made available for examination by the Contractor at the Department's District Office. Utility Adjustment Schedules, when submitted to the Department by the utilities, will be made available to the Contractor after the Notice to Contractors has been posted by the Office of Construction Bidding Administration. The Utility Adjustment Schedules are available on the Office of Construction Bidding Administration's web site. Utility Adjustment Schedules may be included with the Utility Special Provision in the Contract Proposal on select projects. The Contractor is responsible for considering in its bid all existing and proposed utility locations and the removals, relocations, and adjustments specified in the Utility's Work Plan.

For this Project, Utility Owners that are required to remove, relocate, or adjust their facility to accommodate the construction of this Project may be liable to the Contractor

First use date: November 1, 2004
Revised 10/27/04
Revised 01/23/09
Revised 12/23/10
Revised 03/28/11
Revised 08/22/11

Georgia Department of Transportation

State of Georgia

Special Provision

Section 102—Bidding Requirements and Conditions

Delete Subsection 102.01 and Substitute the following:

102.01 Prequalification of Bidders

Before submitting a bid in excess of \$2,000,000, the Bidder shall have been prequalified with the Department and received a Certificate of Qualification in accordance with the Rules and Regulations approved and adopted by the State Transportation Board. Bidders submitting bids of \$2,000,000 or less shall have been registered with the Department. In addition, the aggregate total amount a Non-prequalified Bidder may have under contract shall not exceed \$4,000,000. Bidders intending to consistently submit Proposals shall prequalify at least once a year. However, qualifications may be changed during that period upon the submission of additional favorable reports or upon unsatisfactory performance. In addition, the Department reserves the right at any time to require the Contractor to furnish a current financial and experience statement.

Delete Subsection 102.03 and Substitute the following:

102.03 Contents of Proposal Forms

The Department will make available to the prospective Bidder a Void for Bidding Proposal Form which may be accessed on the Office of Construction Bidding Administration web page. This form will state the location and description of the contemplated construction and will show the approximate estimate of the various quantities and kinds of work to be performed or materials to be furnished, and will have a schedule of Items for which Unit Bid prices are invited. The Proposal Form will state the time in which The Work must be completed, the amount of the Proposal Guaranty, and the date of the opening of Proposals. The Form will also include any Special Provisions or requirements that vary from or are not contained in the *Specifications*. Also included with each Proposal Form will be a Non-Collusion Certificate, Construction Contractors Bid Opportunity List, and Request For Eligibility To Bid. All papers contained in the Proposal Form are considered a part thereof and must not be detached or altered. The Plans, Specifications, and other documents designated in the Proposal Form will be considered a part of the Proposal whether attached or not.

Delete Subsection 102.06 and Substitute the following:

102.06 Preparation of Proposal

The Bidder shall submit its Proposal on the form furnished by the Department (GADOT). The blank spaces on the Proposal shall be filled in correctly for each Pay Item (except alternate items) and the Bidder shall write in ink the Unit Price or a Lump Sum Price as called for in the Proposal for each Pay Item listed therein. In addition, the Bidder shall also show the products of the respective Unit Prices and quantities and the total amount of the Bid by adding the amounts of all Bid Items. In the event of a discrepancy in any of the figures, the Unit Price will govern and the Bid will be recalculated.

In the case of Alternate items, Unit Prices shall be entered for only one alternate.

The Non-Collusion Certificate on the Department's standard form included in the Proposal shall be executed.

The Certificate of Current Capacity shall be executed under oath and substantiated by the report of Status of Contracts on Hand.

The Construction Contractors Bid Opportunity List standard form shall be completed with the required information.

The Prime Contractor's Work Authorization Certification/ E Verify Certification shall be completed with the required information.

The Bidder shall notify the GADOT Office of Construction Bidding Administration by transmitting the completed Request For Eligibility To Bid Form D. O. T. RFETB for each Letting Call Order Number in which the Bidder intends to submit a bid by no later than 12:00 p.m. the day preceding the letting.

If the Proposal is made by an individual, its name and post office address shall be shown; if by a partnership, the name and post office address of one member of the partnership shall be shown; if by a corporation, the Proposal shall show the name, title and business address of the officer signing the Proposal. The Bidder's Proposal shall be signed in ink or by Digital Signature by the individual, by one or more members of a partnership, or by one or more of the officers of a corporation, whichever is applicable. In the event of a joint venture, the Proposal shall be signed in ink or by Digital Signature by each individual involved, by each partnership through one or more of its members, or by each corporation through one or more officers of the corporation, whichever is applicable. Proposals not properly signed may be disqualified and rejected.

All bids shall be submitted using the GADOT/AASHTO (American Association of State Highway and Transportation Officials) Electronic Bidding System (Expedite). When submitting a bid electronically, the Bidder's Proposal shall consist of the Bid pages generated by the Expedite software including the Cover page, Bid Item pages, Disadvantaged Business Enterprise (DBE) pages (if applicable), Miscellaneous Data pages and the Signature page. By submitting a bid electronically, the Bidder acknowledges all requirements included in the proposal, amendments, plans, Standard Specifications, and Supplemental Specifications are a part of the Bid and Contract.

The electronic bid shall be submitted by one of the following methods:

A. Hand delivery of the electronic bid to the Department at the place specified in the Notice To Contractors.

The bid shall include the 3 ½ inch (90 mm) electronic diskette or CD Rom or USB Drive and the Bid pages described in paragraph seven, above.

B. Electronic Bid Submission via the Internet and Bid Express™.

(Note: The Bidder shall secure an account and a valid Digital Signature from Bid Express (www.bidx.com) in order to use this method.

Instructions for preparing and submitting bids by these two methods are as follows:

A. Hand Delivery of Bid to the Department

1. Access to the electronic bidding information is available on Bid Express at www.bidx.com and the GADOT Construction Bidding Administration Internet Web Site at www.dot.ga.gov/doingbusiness/contractors/pages/default.aspx.
2. Electronic bids shall be prepared through the use of a computer controlled printer.
3. The Bidder shall sign the electronic bid in the appropriate areas.
4. When installing the Bid program the Bidder shall enter their vendor code in the following format: 2DO900. Before running the electronic bidding programs, the Bidder shall read the on-line help documentation for the Expedite software.
5. **Zero (0) is considered to be a valid bid. The Bidder shall not enter 0 in any Unit Price field unless zero is the intended bid for that item.**
6. All addenda shall be included in the electronic bid submitted.

7. For “Joint Bids” the Bidder shall select **tools** from the Windows Expedite menu and mark the electronic bid as **“Joint Bid”**.
8. The Bidder shall select **tools** and then **check bid** to check the bid and assure there are no errors prior to printing the electronic bid. After final printing, the Bidder may make changes to the electronic bid by indicating the changes in ink and initialing prior to submitting the bid.
9. Once the Bidder has completed the bid and made all desired changes, the diskette/CD Rom/USB Drive, a printout of the Cover sheet, Bid Item pages, DBE pages (if applicable), Miscellaneous Data pages, and Signature page shall be submitted to the Department. In case of a discrepancy between the diskette and the hard copy of the Bid Item pages, the hard copy will govern.
10. Electronic Bid pages shall be 8 ½ inch (216 mm) horizontal by 11 inch (279 mm) vertical. Bid information shall be placed across the horizontal width on each page.
11. The paper used for an electronic bid shall be of sufficient quality and durability to maintain clear and concise images and to withstand frequent handling.
12. If originally printed on continuous roll paper, electronic bids shall be separated before submitting the Bid to the Department.
13. All computer printed characters shall be legible. The Electronic Bid pages shall be submitted in the bid envelope provided.
14. The diskette shall be submitted in a separate sealed envelope from the Bid pages. The Bidder shall submit all electronic bids on one diskette/CD Rom/USB Drive. The envelope containing the diskette shall include the Bidders name and the Letting Call Order Numbers for which electronic bids are submitted.

B. Electronic Bid Submission Via The Internet And Bid Express™

1. Access to the electronic bidding information is available on Bid Express at www.bidx.com and the GADOT Construction Bidding Administration Internet Web Site at www.dot.ga.gov/doingbusiness/contractors/pages/default.aspx.
2. When installing the Bid program the Bidder shall enter their vendor code in the following format: 2D0900. Before running the electronic bidding programs, the Bidder shall read the on-line help documentation for the Expedite software.
3. **Zero (0) is considered to be a valid bid. The Bidder shall not enter 0 in any Unit Price field unless zero is the intended bid for that item.**
4. All addenda shall be included in the electronic bid submitted.
5. **“Joint Bids” are allowed with Electronic Bid Submission via the Internet and Bid Express**
6. The Bidder shall select **tools** and then **check bid** from the Windows Expedite menu to check the bid and assure there are no errors prior to submitting the electronic bid. The electronic bid may be changed and resubmitted electronically to Bid Express as many times as desired prior to the advertised cutoff time specified in the Notice To Contractors. The last bid submitted for a given Letting Call Order Number prior to the cutoff time will be the Bid.
7. The Bidder shall make no claim against the Department in the event it is unable to submit its bid to Bid Express and/or Bid Express is unable to submit the bid(s) to the Department. The Department reserves the right to postpone the public reading of bids in the event of technical difficulties.

C. A fully executed Proposal Guaranty and Power of Attorney for each Letting Call Order Number bid shall be submitted by one of the following methods:

1. Delivery to the GADOT Office of Construction Bidding Administration, Room 1113, in a sealed envelope by 12:00 noon on the day prior to the Bid Opening. Each Proposal Guaranty shall be clearly and legibly marked with the Letting Call Order Number.
2. Electronic submission via the Internet and Bid Express™ by the time and date set in the Notice To Contractors for submission of Proposals.
The Proposal Guaranty for a “Joint Bid” shall include the names of all Joint Venture parties involved in the bid.

Delete Subsection 102.07 and Substitute the following:

102.07 Rejection of Proposals

Proposals may be rejected as irregular if their consideration is conditioned upon the acceptance or rejection of other Proposals submitted by the same Bidder, if the Prime Contractor's Work Authorization Certification/ E Verify Certification is not completed, if the Request For Eligibility To Bid D.O.T (Form RFETB) has not been submitted, if the Certificate of Current Capacity is not executed under Oath and substantiated, if a Unit Price is not shown for each Pay Item, or if they fail to comply with the EBS bidding requirements. In the case of alternate items, Unit Prices shall be entered for only one alternate. The Department reserves the right to disqualify and reject any Proposal that is not properly signed in accordance with the requisite of [Subsection 102.06](#).

A. Collusion

Any and all Proposals will be rejected if the Department believes that collusion exists among the Bidders and no participant in such collusion may submit future Proposals for the same work. The Department reserves the right to review and to refuse to consider any Proposal if the Bidder fails to execute the Non-Collusion Certificate.

B. Single Proposals

Only one Proposal from any person, partnership, or corporation under the same or different names shall be submitted on any Project.

C. Unbalanced Bids

Proposals may be rejected if any of the Unit Prices are obviously unbalanced. The Department will decide whether any Unit Prices are unbalanced either excessively above or below a reasonable cost analysis value determined by the Engineer, particularly if these unbalanced amounts are substantial and contrary to the interest of the Department.

D. Omissions and Alterations

Proposals may be rejected as irregular if they show any omissions, alterations of form, additions or conditions not called for, unauthorized alternate bids, erasures or changes not initialed, or other irregularities.

E. Debts

The Department reserves the right to reject Proposals from Bidders who have not paid or satisfactorily settled all legal debts due on other Contracts at the time Proposals are received.

F. Technicalities

The Department reserves the right to reject any and all Proposals and to waive technicalities at any time before the Contract has been signed by the Department.

G. Non-Prequalified Bidders

Proposals submitted in excess of \$2,000,000 by non-prequalified contractors under Rule 672-5 of the Department's Rules and Regulations Governing the Prequalification of Prospective Bidders will be disqualified and rejected.

H. Failure to List Disadvantaged Business Enterprise (DBE) Participants

If the contract has an established DBE goal, the Department reserves the right to reject and disqualify any proposal if the bidder has failed to list bona fide DBE participants with sufficient participation to achieve at least the established goal. The Department may consider for award a proposal with less participation than the established goal if both:

- The bidder can demonstrate that no greater participation could be obtained and;
- The participation proposed by the low bidder is not substantially less than the participation proposed by the other bidders on the same contract.

I. Failure to Submit Georgia Security and Immigration Compliance Act Affidavit

- No Proposal will be considered without submission of the completed Georgia Security and Immigration Compliance Act Affidavit for each Letting Call Order Number by no later than the 12:00 p.m. the day preceding the letting.

J. Failure to Submit Request For Eligibility To Bid

No Proposal will be considered without submission of the completed Request For Eligibility To Bid Form for each Letting Call Order Number by no later than the deadline 12:00 p.m. the day prior to the letting.

Delete Subsection 102.09 and Substitute the following:

102.09 Delivery of Proposals

Each Proposal, together with the Proposal Guaranty, shall be submitted in a sealed envelope so marked as to identify its contents without being opened (See Section 102.06 A), unless submitted electronically via the Internet and Bid Express (See Section 102.06 B). Proposal forms are not transferable. Proposals will be received until the time and date set in the Notice To Contractors and shall be in the hands of the officials indicated by that time. Proposals received after the advertised cutoff time established for submission of Proposals will be returned unopened to the Bidder.

Delete Subsection 102.10 and Substitute the following:

102.10 Withdrawal or Revision of Proposals

Any Bidder may withdraw his Proposal by submitting, by telegram, letter, or facsimile transmission received prior to the advertised cutoff time specified in the Notice To Contractors and verified by the Department, a DEPARTMENT OF TRANSPORTATION BID PROPOSAL WITHDRAWAL FORM, completed by an authorized officer of the company, whose signature is legally binding upon said company.

Any Bidder may submit a Bid change, by telegram, letter, or facsimile transmission received prior to the advertised cutoff time specified in the Notice To Contractors and verified by the Department, completed by an authorized officer of the company, whose signature is legally binding upon said company. In which case, the Department will change the Bid at the time of opening and at such time will announce that a change was received.

Add the following:

102.15 Submittal of “Georgia Security and Immigration Compliance Act Affidavit”

All Bidders for each Letting Call Number shall submit the completed “Georgia Security and Immigration Compliance Act Affidavit” to the GADOT Office of Construction Bidding Administration, Room 1113, in a sealed envelope by 12:00 noon on the day prior to the Bid Opening as a matter of Bidder responsibility.

If the “Georgia Security and Immigration Compliance Act Affidavit” is not delivered to the GADOT Office of Construction Bidding Administration, Room 1113, in a sealed envelope by 12:00 p.m. on the day prior to the Bid Opening, the Bid will be subject to rejection.

Add the following:

102.16 Submittal of “Request For Eligibility To Bid”

All Bidders for each Letting Call Number shall submit the completed “Request For Eligibility To Bid Form D. O. T. RFETB” to the GADOT Office of Construction Bidding Administration, Room 1113, by no later than 12:00 p.m. on the day prior to the Bid Opening.

If the “Request For Eligibility To Bid Form D. O. T. RFETB” is not received by the GADOT Office of Construction Bidding Administration, Room 1113, by no later than 12:00 p.m. on the day prior to the Bid Opening , the Bid will be subject to rejection.

Add the following:

102.17 Submittal of “Certificate of Current Capacity” and “Status of Contracts on Hand”

The apparent low Bidder for each Letting Call Number shall submit the executed “Certificate of Current Capacity” and the “Status of Contracts on Hand” to the GADOT Office of Construction Bidding Administration, Room 1113, in a sealed envelope by 12:00 noon on the first working day after the Bid Opening.

If the “Certificate of Current Capacity” and the ‘Status of Contracts on Hand” are not delivered to the GADOT Office of Construction Bidding Administration, Room 1113, in a sealed envelope by 12:00 noon on the first working day after the Bid Opening, the Bid may be subject to disqualification.

Add the following:

102.18 Submittal of “Construction Contractors Bid Opportunity List”

All Bidders for each Letting Call Number shall submit the completed “Construction Contractors Bid Opportunity List” to the GADOT Office of Construction Bidding Administration, Room 1113, in a sealed envelope by 12:00 noon on the third working day after the Bid Opening as a matter of Bidder responsibility.

If the “Construction Contractors Bid Opportunity List” is not delivered to the GADOT Office of Construction Bidding Administration, Room 1113, in a sealed envelope by 12:00 noon on the third working day after the Bid Opening, the Bid may be subject to rejection.

First Use Date: January 14, 2005

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA**

SPECIAL PROVISION

SECTION 102-Bidding Requirements and Conditions

The use of the Electronic Bid Bond Form in Expedite will be accepted by the Department for compliance with the Notice To Contractors requirement to utilize the "Bid Bond Form DOT 564-Rev. Dec. 13, 2004".

**Department of Transportation
State of Georgia**

Special Provision

Section 104 – Scope of Work

Delete Subsection 104.08 and Substitute the following:

104.08 Value Engineering Proposals

A. Applicability

This Section applies to those cost reduction proposals initiated and developed by the Contractor for changing the Plans, Specifications, or other requirements of the Contract. These provisions do not apply unless the proposal submitted by the Contractor is specifically identified as being presented as a Value Engineering Proposal (VEP) and the Contract amount is in excess of \$50,000.

The cost-reduction Proposals contemplated are those discretionary changes which would require a Supplemental Agreement modifying the Contract and would produce a savings to the Department by providing less costly items or methods than those specified in the Contract without impairing essential functions and characteristics including, but not limited to: service life, reliability, economy of operations, ease of maintenance, and safety, both during and after construction. Proposals must provide a product comparable to the original design at a lower cost or improved quality, or both. No proposals will be accepted that lower the quality of the project.

These provisions are applicable to the prime Contract and include all subcontracts.

B. Documentation

Value Engineering Proposals (VEP) will be processed in the same manner as prescribed for any other alterations of the Contract requiring a Supplemental Agreement.

As a minimum, the following information shall be submitted by the Contractor with each Value Engineering Proposal:

1. A description of the difference between the existing Contract requirement and the proposed change and the comparative advantages and disadvantages of each.
2. An itemization of the requirements of the Contract which must be changed and a recommendation of how to make such change (e.g., a suggested revision).
3. A detailed estimate of the cost of performing the work under the Contract and under the proposed change.
4. A prediction of any effects the proposed changes would have on other costs to the Department, including cost of related items and costs of maintenance and operation.
5. A statement of the time showing the last date by which an agreement for adoption of the proposed changes must be executed in order to obtain the maximum cost reduction during the remainder of the Contract, noting any effect on the Contract completion time or delivery schedule.
6. The dates of any previous or concurrent submissions of the Proposal, the Contract number(s) under which submitted, and the outcome or the result of the proposal in previous projects and any previous actions by the Department, if known.
7. A life-cycle cost analysis.

NOTE: If a VEP is similar to a change in the Plans or Specifications for the Project that is under consideration by the Department at the time said VEP is submitted, or if such VEP is based upon or similar to Standard Specifications, Special Provisions, or Standard Plans adopted by the Department after the advertisement of the Contract, the Engineer will not accept such proposal and the Department reserves the right to make such changes without compensation to the Contractor under the provisions of this Section.

Proposed changes in the basic design of a pavement type (e.g., rigid to flexible or vice versa) or pavement thickness will not be considered as an acceptable VEP. Proposed changes to base/subbase courses may be considered as an acceptable VEP. If design alternates are shown in the plans, the Department will not consider a VEP substituting a design alternate on which the Contractor could have bid for one on which the Contractor has bid. The Department reserves the right to reject any VEP submitted requiring additional Right-of-Way.

C. Submission

Value Engineering Proposals submitted by the Contractor will be processed as expeditiously as possible; however, the Department will not be liable for any delay in acting upon proposals submitted. The Contractor may withdraw, wholly or in part, any VEP not accepted by the Department within the time specified in [Subsection 104.08.B.5](#).

D. Acceptance

The decision of the Engineer as to the acceptance or rejection of a VEP shall be final and shall not be subject to the provisions of [Subsection 105.13](#), "Claims for Adjustments and Disputes."

The Engineer may accept, in whole or in part, before work has been completed, any VEP submitted pursuant to this Subsection and not withdrawn by the Contractor by giving the Contractor written notice thereof reciting acceptance under this Subsection.

E. Notification

The Contractor will be notified in writing of the Department's decision or rejection of each VEP submitted under these provisions. If a proposal is accepted, the necessary Contract modifications will be affected by execution of a Supplemental Agreement. Unless and until a VEP is affected by such Supplemental Agreement, the Contractor shall remain obligated to perform The Work in accordance with the terms of the existing Contract.

Supplemental Agreements made as a result of this Subsection will state that they are made pursuant to it.

F. Sharing

In the event a VEP submitted by the Contractor under this Subsection is accepted, the Supplemental Agreement effecting the necessary modifications will establish the net savings agreed upon and will provide for an adjustment in Contract Prices that will divide the net savings between the Contractor and the Department in accordance with the following provisions:

1. Division of net savings in Contract Price Adjustment:
 - 50 percent of the net savings to the Contractor.
 - 50 percent of the net savings to the Department.
2. The Department reserves the right to include in the agreement any conditions it deems appropriate for consideration, approval, and implementation of the VEP. The Contractor's 50 percent of the net savings shall constitute the full compensation for effecting all changes pursuant to the agreement.

Development costs incurred by the Contractor and review costs incurred by the Department shall not be considered in computing the net savings of the VEP.
3. Restrictions and Disclosures: Upon acceptance and implementation of any VEP, any restrictions imposed by the Contractor on its use or disclosure of the information submitted shall be void.

The Department shall thereafter have the right to use, duplicate, and disclose, in whole or in any part, all data necessary in the utilization of the proposal.

**Department of Transportation
State of Georgia**

Supplemental Specification

Section 107—Legal Regulations and Responsibility to the Public

Delete Subsection 107.23 and Substitute the following:

107.23 Environmental Considerations

A. Construction

Erosion control measures shall be installed, to the greatest practical extent, prior to clearing and grubbing. Particular care shall be exercised along stream buffers, wetlands, open waters and other sensitive areas to ensure that these areas are not adversely affected.

Construction equipment shall not cross streams, rivers, or other waterways except at temporary stream crossing structures approved by the Engineer.

Construction activities within wetland areas are prohibited except for those within the construction limits as shown on the Plans and as specified in Subsection 107.23.E.

All sediment control devices (except sediment basins) installed on a project shall, as a minimum, be cleaned of sediment when one half the capacity, by height, depth or volume, has been reached. Sediment basins shall be cleaned of sediment when one-third the capacity by volume has been reached.

B. Bridge Construction Over Waterways

Construction waste or debris, from bridge construction or demolition, shall be prevented from being allowed to fall or be placed into wetlands, streams, rivers or lakes.

Excavation, dewatering, and cleaning of cofferdams shall be performed in such a manner as to prevent siltation. Pumping from cofferdams to a settling basin or a containment unit will be required if deemed necessary by the Engineer.

Operations required within rivers or streams, i.e. jetting or spudding, shall be performed within silt containment areas, cofferdams, silt fence, sediment barriers or other devices to minimize migration of silt off the project.

C. Borrow and Excess Material Pits

Specific written environmental clearance from the Engineer will be required for any sites not included in the Plans as excess material or borrow areas. No work other than testing shall be started at any potential excess material or borrow site not shown on the plans prior to receiving said environmental clearance from the Engineer.

The Engineer will require a written notice from the Contractor requesting environmental clearance studies and written permission from the property owner at least six weeks prior to intended use of the site. The Department will not begin studies on such sites before a Notice to Proceed is issued.

The Engineer will inform the Contractor in writing as to the granting or denial of environmental clearance. If denied, the Contractor may, at no expense to the Department, seek to obtain permits or pursue other remedies that might otherwise render the site(s) acceptable.

Sites included in the Plans have environmental clearance and shall be used only for the purpose(s) specified in the Plans or other contract documents. Should the Contractor wish to expand or utilize said sites for any purpose other than that provided for in the Plans or other contract documents, specific written environmental clearance as noted above shall be obtained.

D. Control of Pollutants

Pollutants or potentially hazardous materials, such as fuels, lubricants, lead paint, chemicals or batteries, shall be transported, stored, and used in a manner to prevent leakage or spillage into the environment. The Contractor shall also be responsible for proper and legal disposal of all such materials.

Equipment, especially concrete or asphalt trucks, shall not be washed or cleaned-out on the Project except in areas where unused product contaminants can be prevented from entering waterways.

E. Temporary Work in Wetlands Outside of the Construction Limits within the Right-of-Way and Easement Areas

Temporary work in wetlands (that are not delineated with orange barrier fence) will be subject to the following requirements:

1. Temporary work in wetlands shall be accomplished by using temporary structures, timber, concrete, soil with geotextile fabric, or other suitable matting. The area shall not be grubbed.
2. Soil matting shall be protected from erosion in accordance with the Specifications.
3. Whenever temporary work is required in Saltwater Marsh Wetlands, all temporary structures and/or matting shall be removed in their entirety prior to Final Acceptance of the Project. Matted and compressed soils shall be backfilled to their original ground elevation with material meeting the requirements of [Section 212 – Granular Embankment](#).
4. Whenever temporary work is required in Freshwater Wetlands, all temporary structures and/or matting (exclusive of soil matting to be retained in the final roadway section) shall be removed in their entirety prior to Final Acceptance of the Project.

Once the temporary materials have been removed, the area shall be covered by Excelsior or Straw blankets according to [Section 713](#) of the Specifications. The grassing and ground preparation referenced in [Subsection 713.3.03, “Preparation”](#), will not be applicable to this Work.

5. The Engineer shall be notified so that a field inspection may be conducted to certify that the temporary materials were properly removed and that the area was properly restored. The Contractor shall be responsible for any corrective action required to complete this Work.
6. There will be no separate measurement or payment for this Work. The cost associated with this work shall be included in the overall Bid submitted.

F. Environmentally Sensitive Areas

Some archaeological sites, historic sites, wetlands, streams, open waters and protected animal and plant species habitats within the Right-of-Way and easement areas may be designated as ENVIRONMENTALLY SENSITIVE AREAS (ESAs). These areas are shown on the Plan sheets and labeled “ESA” (e.g. ESA – Historical Boundary, ESA – Wetland Boundary). The Contractor shall install orange barrier fence as delineated in the Plans.

The Contractor shall not perform any construction related activities within areas delineated in the Plans with orange barrier fence, unless specifically stated otherwise in the Plans. This includes but is not limited to construction activities such as clearing and grubbing, borrowing, wasting, grading, filling, staging, parking, sediment basins, and equipment storage. Also, all archaeological sites, historic sites, wetlands, streams and protected habitats beyond the Right-of-Way and easement areas are deemed to be ENVIRONMENTALLY SENSITIVE AREAS and shall not be disturbed in any way.

The orange barrier fence shall remain in place until such time the Engineer directs the fence to be removed. The cost of this work shall be included in the Bid price submitted for barrier fence which will be paid for in accordance with Specification 643.

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA**

SPECIAL PROVISION

Section 108—Prosecution and Progress

Delete the fifth paragraph from Subsection 108.01 and substitute the following:

No Subcontracts, or transfer of Contract, shall in any case release the Prime Contractor of his/her liability under the Contract and Bonds. No Subcontractor shall commence work in advance of the written approval of the Subcontract by the Department. Except for certain items exempted by the State Transportation Board, each Subcontractor shall be prequalified or registered with the Department. Each Subcontract for a Registered Subcontractor shall not exceed \$1,000,000.00 and Subcontracts for Prequalified Contractors shall not exceed their current capacity. Prequalified or Registered Subcontractors shall be qualified or registered with the Department in accordance with Chapter 672-5 of the Rules and Regulations Governing the Prequalification of Prospective Bidders adopted by the State Transportation Board.

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA**

SUPPLEMENTAL SPECIFICATION

Section 108-Prosecution and Progress

Delete subsection 108.08 in its entirety and substitute the following:

108.08 Failure or Delay in Completing Work on Time

Time is an essential element of the Contract, and any delay in the prosecution of The Work may inconvenience the public, obstruct traffic, or interfere with business. In addition to the aforementioned inconveniences, any delay in completion of The Work will always increase the cost of engineering. For this reason, it is important that The Work be pressed vigorously to completion. Should the Contractor or, in case of default, the Surety fail to complete The Work within the time stipulated in the Contract or within such extra time that may be allowed, charges shall be assessed against any money due or that may become due the Contractor in accordance with the following schedule:

Schedule of Deductions for Each Day of Overrun in Contract Time		
Original Contract Amount		Daily Charges
From More Than	To and Including	Calendar Day, Completion Date or Available Day
\$0	\$500,000	\$84
\$500,000	\$1,000,000	\$151
\$1,000,000	\$2,000,000	\$247
\$2,000,000	\$5,000,000	\$391
\$5,000,000	\$10,000,000	\$713
\$10,000,000	\$20,000,000	\$1191
\$20,000,000	\$40,000,000	\$1869
\$40,000,000	—	\$5089

For each Calendar Day or Available Day, as specified, that any work shall remain uncompleted after the contract time specified for the completion of the Work required by the Contract, the sum specified in the Contract will be deducted from any money due the Contractor, not as a penalty, but as liquidated damages; provided however, that due account shall be taken of any adjustment of the contract time for completion of the work granted under the provisions of [Subsection 108.07.E](#).

The Department may waive such portions of the liquidated damages as may accrue after the work is in condition for safe and convenient use by the traveling public.

A. Liquidated Damages

The amount of such charges is hereby agreed upon as fixed liquidated damages due the Department after the expiration of the time for completion specified in the Contract. The Contractor and his Surety shall be liable for liquidated damages in excess of the amount due the Contractor on the final payment.

These fixed liquidated damages are not established as a penalty but are calculated and agreed upon in advance by the Department and the Contractor due the uncertainty and impossibility of making a determination as to the actual and consequential damages which are incurred by the Department as a result of the failure on the part of the Contractor to complete The Work on time.

1. **Deduction From Partial Payments:** Liquidated damages, as they accrue, will be deducted from periodic partial payments.
2. **Deduction From Final Payment:** The full amount of liquidated damages will be deducted from final payment to the Contractor and/or his Surety.
3. **No Liquidated Damages Charged for Delay by the Department:** In case of default of the Contract and the subsequent completion of The Work by the Department as hereinafter provided, the Contractor and his Surety shall be liable for the liquidated damages under the Contract, but no liquidated damages shall be chargeable for any delay in the final completion of The Work by the Department due to any unreasonable action, negligence, omission, or delay of the Department. In any suit for the collection of or involving the assessment of liquidated damages, the reasonableness of the amount shall be presumed. The liquidated damages referred to herein are intended to be and are cumulative and shall be in addition to every other remedy now or hereafter enforceable at law, in equity, by statute, or under the Contract.

B. No Waiver of Department's Rights

Permitting the Contractor to continue and finish The Work or any part of it after the expiration of the time allowed for completion or after any extension of time, shall not operate as a waiver of the rights of the Department under the Contract.

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA**

SPECIAL PROVISION

Section 109—Measurement and Payment

109.01 Measurement and Quantities

The method of measurement and computations to be used in determination of quantities of material furnished and of 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 along the surface, and no deductions will be made for individual fixtures having an area of 9 ft² (1 m²) or less. Unless otherwise specified, transverse measurements for area computations will be the neat dimensions shown on the Plans or ordered in writing by the Engineer.

Where payment is to be made by the square yard (square meter) for a specified thickness, the length will be measured on the surface along the centerline and the pay width shall be that width specified on the plans for the Final surface of the completed section. Intermediate courses shall be placed at a width sufficient to support successive courses with no detriment to the stability of the successive courses. The width of material required beyond the pay width will not be eligible for payment and shall be considered incidental to the work.

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

All items which are measured by the linear foot (linear meter), such as pipe culverts, guard rail, 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 term “gage,” when used in connection with the measurement of steel plates, will mean the U.S. Standard Gage.

When the term “gage” refers to the measurement of electrical wire it will mean the wire gage specified in the National Electrical Code.

The term “ton” will mean the short ton consisting of 2,000 pounds avoirdupois. The term “megagram” will mean one metric ton, equivalent to 1,000 kg. Any commodity paid for by weight shall be weighed on scales that have been approved as specified below and which are furnished at the expense of the Contractor or Supplier. Weighing and measuring systems including remote controls shall be subject to type-approval by the Department of Transportation. The manufacture, installation, performance, and operation of such devices located in Georgia shall conform to, and be governed by, the Official Code of Georgia, Annotated, Section 10-2-5 of the Georgia Weights and Measures Act, the Georgia Weights and Measures Regulations, as amended and adopted, the current edition of the National Bureau of Standards Handbook 44, and these Specifications. Weighing and measuring systems located outside Georgia which are utilized for weighing materials to be used in Department work shall be manufactured, installed, approved, and operated in accordance with applicable laws and regulations for the state in which the scales are located.

All weighing, measuring, and metering devices used to measure quantities for payment shall be suitable for the purpose intended and will be considered to be “commercial devices.” Commodity scales located in Georgia shall be certified before use for accuracy, condition, etc., by the Weights and Measures Division of the Georgia Department of Agriculture, its authorized representative, or the Georgia Department of Transportation Office of Materials and Research. Scales located outside Georgia shall be certified in accordance with applicable laws and regulations for the state in which the scales are located. The Georgia Department of Transportation Office of Materials and Research may certify the scales. This certification shall have been made within a period of not more than one year prior to date of use for weighing commodity.

All equipment and all mechanisms and devices attached thereto or used in connection therewith shall be constructed, assembled, and installed for use so that they do not facilitate the perpetration of fraud. Any scale component or mechanism, which if manipulated would alter true scale values (including manual zero setting mechanisms) shall not be accessible to the

Section 109—Measurement and Payment

scale operator. Such components and mechanisms that would otherwise be accessible to the scale operator shall be enclosed. Provisions shall be made for security seals where appropriate on equipment and accessories. A security seal shall be affixed to any adjustment mechanism designed to be sealed. Scale or accessory devices shall not be used if security seals have been broken or removed.

Any certified scale or scale component which has been repaired, dismantled, or moved to another location shall again be tested and certified before it is eligible for weighing.

Whenever materials that are paid for based on weight are from a source within the State, the scales shall be operated by and the weights attested to by signature and seal of a duly authorized Certified Public Weigher in accordance with Standard Operating Procedure 15 and the Official Code of Georgia, Annotated, Section 10-2-5 of the Georgia Weights and Measures Act as amended and adopted. When such materials originate from another state that has a certified or licensed weigher program, the scales shall be operated by a weigher who is certified by that state in accordance with applicable laws, and weight ticket recordation shall be in accordance with Standard Operating Procedure 15.

When materials are paid for based on weight and originate from another state which has no program for certifying or licensing weighers, the materials shall be weighed on scales located in the State of Georgia by a Certified Public Weigher in accordance with Standard Operating Procedure 15 and the Official Code of Georgia, Annotated, Section 10-2-5 of the Georgia Weights and Measures Act as amended and adopted.

No scale shall be used to measure weights greater than the scale manufacturer's rated capacity. A digital recorder shall be installed as part of any commodity scale. The recorder shall produce a printed digital record on a ticket with the gross, tare, and net weights of the delivery trucks, along with the date and time printed for each ticket. Provisions shall be made so that the scales or recorders may not be manually manipulated during the printing process. The system shall be so interlocked as to allow printing only when the scale has come to rest. Either the gross or net weight shall be a direct scale reading. Printing and recording systems that are capable of accepting keyboard entries shall clearly and automatically differentiate a direct scale weight value from any other weight values printed on the load ticket.

All scales used to determine pay quantities shall be provided to attain a zero balance indication with no load on the load receiving element by the use of semi-automatic zero (push-button zero) or automatic zero maintenance.

Vehicle scales shall have a platform of sufficient size to accommodate the entire length of any vehicle weighed and shall have sufficient capacity to weigh the largest load. Adequate drainage shall be provided to prevent saturation of the ground under the scale foundation.

The Engineer, at his discretion, may require the platform scales to be checked for accuracy. For this purpose the Contractor shall load a truck with material of his choosing, weigh the loaded truck on his scales, and then weigh it on another set of certified vehicle scales. When the difference exceeds 0.4 percent of load, the scales shall be corrected and certified by a registered scale serviceman registered in the appropriate class as outlined in the Georgia Weights and Measures Regulations or in accordance with applicable requirements of the state in which the scales are located. A test report shall be submitted to the appropriate representative of the Department of Agriculture.

Materials to be measured by volume in the hauling vehicle shall be hauled in approved vehicles and measured therein 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 contents may be readily and accurately determined. All vehicles shall be loaded to their water level capacity as determined by the Engineer, provided that the body is of such shape that the actual contents may be readily and accurately determined.

Cement and lime will be measured by the ton (megagram). Whenever cement or lime is delivered to the Project in tank trucks, a certified weight shall be made at the shipping point by an authorized Certified Public Weigher who is not an employee of the Department. Whenever cement and lime are from a source within the State, the scales shall be operated by the weights attested to by signature and seal of a duly authorized Certified Public Weigher in accordance with Standard Operating Procedure 15 and the Official Code of Georgia, Annotated, Section 10-2-5 of the Georgia Weights and Measures Act as amended and adopted. When such materials originate from another state that has a certified or licensed weigher program, the scales shall be operated by a weigher who is certified by that state in accordance with applicable laws, and the weight ticket recordation shall be in accordance with Standard Operating Procedure 15. When cement and lime originate from another state that has no program for certifying or licensing weighers, the materials shall be weighed on scales located in the State of Georgia by a Certified Public Weigher in accordance with Standard Operating Procedure 15 and the Official Code of Georgia, Annotated, Section 10-2-5 of the Georgia Weights and Measures Act as amended and adopted.

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The shipping invoice shall contain the certified weights and the signature and seal of the Certified Public Weigher. A security seal shall also be affixed to the discharge pipe cap on the tank truck before leaving the shipping point. The number on the security seal shall also be recorded on the shipping invoice. The shipping invoice for quicklime shall also contain a certified lime purity percentage. Unsealed tank trucks will require reweighing by a Certified Public Weigher.

Timber will be measured by the thousand feet board measure (MFBM) (cubic meter) actually incorporated in the structure. Measurements will be based on nominal widths and thickness and the actual length in place. No additional measurement will be made for splices except as noted for overlaps as shown on the Plans.

The term “Lump Sum” when used as an item of payment will mean complete payment for the Work described in the Contract.

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

Rental of equipment will be measured as defined in [Subsection 109.05.B.4](#).

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

109.02 Measurement of Bituminous Materials

A. By Weighing the Material

The Department prefers this method whenever it is practicable. This method will be considered acceptable under the following conditions:

- 1. Weighed On Project:** If the weights of the bituminous materials delivered by tank trucks are to be determined on the Project, weights shall be determined on scales that have been previously checked by the Department with standard weights for accuracy. The scale platform shall be large enough to accommodate the entire vehicle at one time. Under no conditions will truck scales be used to measure weights greater than their rated capacity. All weights not determined in the presence of an authorized representative of the Department shall be made by a Certified Public Weigher who is not an employee of the Department of Transportation and who is in good standing with the Georgia Department of Agriculture. The weight tickets shall carry both the signature and seal of the Certified Public Weigher.
- 2. Weighed At Shipping Point:** A certified weight made at the shipping point by an authorized Certified Public Weigher who is not an employee of the Department of Transportation and who is registered with the Georgia Department of Agriculture, will be acceptable provided all openings in the tank have been sealed by the producer and when, upon inspection on the Project, there is no evidence of any leakage. The shipping ticket in this case must carry the signature and seal of the Certified Public Weigher. If the tank is not completely emptied the amount of material remaining in the tank truck will be measured by either weight or volume and the amount so determined, as verified by the Engineer, will be deducted from the certified weight.
- 3. By Extraction Analysis:** The weight of bituminous material used will be determined by extraction tests made by the field laboratory. The average asphalt content for each Lot will be used to compute the weight of the Asphalt Cement to be paid for in accordance with the following formula:

English:

$$P = \% AC \times T$$

Where:

P = Pay Tons of Asphalt Cement

% AC = Lot average of % Asphalt Cement by weight of total mix as determined by extraction

T = Actual accepted tons of mixture as weighed

Metric:

$$P = \% AC \times T$$

Where:

P = Pay megagrams of Asphalt Cement

% AC = Lot average of % Asphalt Cement by weight of total mix as determined by extraction

T = Actual accepted megagrams of mixture as weighed

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4. **By Digital Recording Device:** The amount of bituminous material as shown on the printed tickets will be the Pay Quantity.

B. By Volume

The volume will be measured and corrected for the difference between actual temperature and 60 °F (15 °C). Containers shall be level when measured, and one of the following methods shall be used, whichever is best suited to the circumstances:

1. **Tank Car Measurement:** If the material is shipped to the Project in railroad tank cars, the Contractor shall furnish the Engineer a certified chart showing the dimensions and volume for each inch (25 mm) of depth for each tank. The Engineer will make outage and temperature measurements before unloading is begun and after it is finished. The measurements will be taken when the bituminous material is at a uniform temperature and free from air bubbles. The Contractor shall not remove any bituminous material from any tank until necessary measurements have been made nor shall he release the car until final outage has been measured. The total number of gallons (liters) allowed for any tank car shall not be more than the U.S. Interstate Commerce Commission rating for that car, converted to gallons at 60 °F (15 °C).
2. **Truck Measurement:** If bituminous materials are delivered to the Project in tank trucks, distributor tanks, or drums, the Contractor shall not remove any bituminous material from the transporting vehicle or container until necessary measurements have been made, nor shall the transporting vehicle or container be released until final outage has been measured. If weighing is not convenient, the Contractor shall furnish the Engineer with a certified chart showing the dimensions and volume of each container together with a gauge or calibrated measuring rod which will permit the volume of the material to be determined by vertical measurement.
3. **Metering:** The volume may be determined by metering, in which case the metering device used and the method of using it shall be subject to the approval of the Engineer.
4. **Time of Deliveries:** The arrival and departure of vehicles delivering bituminous materials to the Project site shall be so scheduled that the Engineer is afforded proper time for the measurements of delivered volume and final outage. The Engineer will make the necessary measurements only during the Contractor's normal daily working hours.

C. Production for Multiple Projects

When a Contractor is producing Asphaltic Concrete from one plant, which is being placed on two or more jobs, public or private, the amount of bituminous material used may be determined by extraction tests in accordance with [Subsection 109.02.A.3](#) or digital recording device in accordance with [Subsection 109.02.A.4](#).

D. Tack Coat

When the same storage facility is utilized for Bituminous Materials to be used in Hot Mix Asphaltic Concrete, Bituminous Tack Coat, and/or Surface Treatment, the quantity used for Tack Coat shall be converted to tons (megagrams) and deducted from the quantities for the Bituminous Material used in the Hot Mix Asphaltic Concrete and Surface Treatment.

E. Corrections

When the volume and temperature have been determined as defined above, the volume will be corrected by the use of the following formula:

$$V_{\text{English}} = \frac{V1}{K(t-60) + 1} \qquad V_{\text{metric}} = \frac{V1}{K(t-15) + 1}$$

Where:

V = Volume of bituminous material at 60 °F (15 °C)

V1= Volume of hot bituminous material

t = Temperature of hot bituminous material in degrees Fahrenheit (Celsius)

K= Coefficient of Expansion of bituminous material (correction factor)

The correction factors K for various materials are given below:

- 0.00035 (0.00063) per °F (°C) for petroleum oils having a specific gravity of 60 °F/60 °F (15 °C/15 °C) above 0.966
- 0.00040 (0.00072) per °F (°C) for petroleum oils having a specific gravity of 60 °F/60 °F (15 °C/15 °C) between 0.850-0.966

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- 0.00030 (0.00054) per °F (°C) for Tar
- 0.00025 (0.00045) per °F (°C) for Emulsified Asphalt
- 0.00040 (0.00072) per °F (°C) for Creosote Oil

109.03 Scope of Payment

The Contractor shall receive and accept the compensation provided for in the Contract as full payment for furnishing all materials, labor, tools, equipment, superintendence and incidentals, and for performing all work contemplated and embraced under the Contract in a complete and acceptable manner, for any infringement of patent, trademark or copyright, for all loss or damage arising from the nature of The Work, or from the action of the elements, for all expenses incurred by or in consequence of the suspension or discontinuance of The Work, or from any unforeseen difficulties which may be encountered during the prosecution of The Work and for all risks of every description connected with the prosecution of The Work until its Final Acceptance by the Engineer, except as provided in [Subsection 107.16](#).

The payment of any partial estimate prior to Final Acceptance of the Project as provided in [Subsection 105.16](#) shall in no way affect the obligation of the Contractor to repair or renew any defective parts of the construction or to be responsible for all damages due to such defects.

109.04 Payment and Compensation for Altered Quantities

When alteration in Plans or quantities of work not requiring Supplemental Agreements as herein before provided for are ordered and performed, the Contractor shall accept payment in full at the Contract Unit Bid Prices for the actual quantities of work done, and no allowance will be made for increased expense, loss of expected reimbursement, or loss of anticipated profits suffered or claimed by the Contractor, resulting either directly from such alterations, or indirectly from unbalanced allocation among the Contract Items of overhead expense on the part of the Bidder and subsequent loss of expected reimbursement therefore, or from any other cause.

Compensation for alterations in Plans or quantities of work requiring Supplemental Agreements shall be as stipulated in such agreement, except that when the Contractor proceeds with the Work without change of price being agreed upon, he shall be paid for such increased or decreased quantities at the Contract Unit Prices Bid in the Proposal for the Items of the Work.

109.05 Extra Work

Extra work, as defined in [Subsection 101.27](#), when ordered in accordance with [Subsection 104.04](#), will be authorized in writing by the Engineer. The authorization will be in the form of a Supplemental Agreement or a Force Account.

A. Supplemental Agreement

In the case of a Supplemental Agreement, the work to be done will be stipulated and agreed upon by both parties prior to any extra work being performed.

Payment based on Supplemental Agreements shall constitute full payment and settlement of all additional costs and expenses including delay and impact damages caused by, arising from or associated with The Work performed.

B. Force Account

When no agreement is reached for Extra Work to be done at Lump Sum or Unit Prices, such work may be authorized by the Department to be done on a Force Account basis. A Force Account estimate that identifies all anticipated costs shall be prepared by the Contractor on forms provided by the Engineer. Work shall not begin until the Force Account is approved. Payment for Force Account work will be in accordance with the following:

1. **Labor:** For all labor, equipment operators and supervisors, excluding superintendents, in direct charge of the specific operations, the Contractor shall receive the rate of wage agreed upon in writing before beginning work for each and every hour that said labor, equipment operators and supervisors are actually engaged in such work.

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 15% of the sum of the above items will also be paid the Contractor.

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2. **Bond, Insurance, and Tax:** For property damage, liability, and worker's compensation insurance premiums, unemployment insurance contributions, and Social Security taxes on the Force Account work, the Contractor shall receive the actual cost, to which cost no percentage will be added. The Contractor shall furnish satisfactory evidence of the rate or rates paid for such bond, insurance, and tax.
3. **Materials:** For materials accepted by the Engineer and used, the Contractor shall receive the actual cost of such material incorporated into The Work, including Contractor paid transportation charges (exclusive of machinery rentals as hereinafter set forth), to which cost 10% will be added.
4. **Equipment:** For any machinery or special equipment (other than small tools) including fuel and lubricant, plus transportation costs, the use of which has been authorized by the Engineer, the Contractor shall receive the rental rates indicated below for the actual time that such equipment is in operation on The Work or the time, as indicated below, the equipment is directed to stand by.

Equipment rates shall be based on the latest edition of the *Rental Rate Blue Book for Construction Equipment* or *Rental Rate Blue Book for Older Construction Equipment*, whichever applies, as published by EquipmentWatch using all instructions and adjustments contained therein and as modified below.

Allowable Equipment Rates shall be established as defined below:

- Allowable Hourly Equipment Rate = Monthly Rate/176 x Adjustment Factors.
- Allowable Hourly Operating Cost = Hourly Operating Cost.
- Allowable Rate Per Hour = Allowable Hourly Equipment Rate + Allowable Hourly Operating Cost.
- Standby Rate = Allowable Hourly Equipment Rate x 35%

NOTE: The monthly rate is the basic machine plus any attachments.

Standby rates shall apply when equipment is not in operation and is directed by the Engineer to standby for later use. In general, Standby rates shall apply when equipment is not in use, but will be needed again to complete The Work and the cost of moving the equipment will exceed the accumulated standby cost. Payment for standby time will not be made on any day the equipment operates for 8 or more hours. For equipment accumulating less than 8 hours operating time on any normal workday, standby payment will be limited to only that number of hours which, when added to the operating time for that day equals 8 hours. Standby payment will not be made on days that are not normally considered workdays.

The Department will not approve any rates in excess of the rates as outlined above unless such excess rates are supported by an acceptable breakdown of cost.

Payable time periods will not include:

- Time elapsed while equipment is broken down
- Time spent in repairing equipment, or
- Time elapsed after the Engineer has advised the Contractor the equipment is no longer needed

If a piece of equipment is needed which is not included in the above *Blue Book* rental rates, reasonable rates shall be agreed upon in writing before the equipment is used. All equipment charges by persons or firms other than the Contractor shall be supported by invoices.

Transportation charges for each piece of equipment to and from the site of the Work will be paid provided:

- The equipment is obtained from the nearest approved source
- The return charges do not exceed the delivery charges
- Haul rates do not exceed the established rates of licensed haulers, and
- Such charges are restricted to those units of equipment not already available and not on or near the Project

No additional compensation will be made for equipment repair.

5. **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.
6. **Compensation:** The Contractor's representative and The Engineer shall compare records and agree on the cost of work done as ordered on a Force Account basis at the end of each day on forms provided by the Department.
7. **Subcontract Force Account Work:** For work performed by an approved Subcontractor or Second-tier Subcontractor, all provisions of this Section (109.05) that apply to the Prime Contractor in respect to labor, materials

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and equipment shall govern. The prime Contractor shall coordinate the work of his Subcontractor. The prime Contractor will be allowed an amount to cover administrative cost equal to 5% of the Subcontractor's amount earned but not to exceed \$5,000.00 per Subcontractor. Markup for Second-tier Subcontract work will not be allowed.

Should it become necessary for the Contractor or Subcontractor to hire a firm to perform a specialized type of work or service which the prime Contractor or Subcontractor is not qualified to perform, payment will be made at reasonable invoice cost. To each invoice cost a markup to cover administrative cost equal to 5% of the total invoice but not to exceed \$5,000.00 will be allowed the Contractor or Subcontractor but not both.

8. **Statements:** No payment will be made for work performed on a Force Account basis until the Contractor has furnished the Engineer with duplicate itemized statements of the cost of such Force Account work detailed as follows:
 - a. Name, classification, date, daily hours, total hours, rate, and extension for each laborer, equipment operator, and supervisor, excluding superintendents.
 - b. Designation, dates, daily hours, total hours, rental rate, and extension for each unit of machinery and equipment.
 - c. Quantities of materials, prices, and extensions.
 - d. Transportation of materials.
 - e. Cost of property damage, liability, and worker's compensation insurance premiums, unemployment insurance contributions, and Social Security tax.

Statements shall be accompanied and supported by invoices for all materials used and transportation charges. However, if materials used on the Force Account work are not purchased specifically 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 his stock, that the quantity claimed was actually used, and that the price and transportation claimed represent the actual cost to the Contractor.

Payment based on Force Account records shall constitute full payment and settlement of all additional costs and expenses including delay and impact damages caused by, arising from or associated with The Work performed.

109.06 Eliminated Items

Should any Items contained in the Proposal be found unnecessary for the proper completion of The Work, the Engineer may, upon written order to the Contractor, eliminate such Items from the Contract, and such action shall in no way invalidate the Contract. When a Contractor is notified of the elimination of Items, he will be reimbursed for actual work done and all costs incurred, including mobilization of materials prior to said notifications.

109.07 Partial Payments

A. General

At the end of each calendar month, the total value of Items complete in place will be estimated by the Engineer and certified for payment. Such estimate is approximate only and may not necessarily be based on detailed measurements. Value will be computed on the basis of Contract Item Unit Prices or on percentage of completion of Lump Sum Items.

When so requested by the Contractor and approved by the Engineer, Gross Earnings of \$500,000.00 or more for work completed within the first 15 days of any month will be certified for payment on a semi-monthly basis subject to the conditions and provisions of Subsection 109.07.A, Subsection 109.07.B.6, Subsection 109.07.C, Subsection 109.07.D, Subsection 109.07.E, and Subsection 109.07.F.

B. Materials Allowance

Payments will be made on delivered costs, or percentage of bid price if otherwise noted, with copies of paid invoices provided to the Department for the materials listed below which are to be incorporated into the Project provided the materials:

- Conform to all Specification requirements.

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- Are stored on the Project Right-of-Way or, upon written request by the Contractor and written approval of the Engineer, they may be stored off the Right-of-Way, but local to the Project, provided such storage is necessary due to lack of storage area on the Right-of-Way, need for security, or need for protection from weather.

As a further exception to on-Project storage, upon written request by the Contractor, the Engineer may approve off-the-Project storage items uniquely fabricated or precast for a specific Project, such as structural steel and precast concrete, which will be properly marked with the Project number and stored at the fabrication or precast facility.

The Engineer may approve out-of-state storage for structural steel and prestressed concrete beams uniquely fabricated for a specific Project stored at the fabrication facility.

1. Paid invoices should accompany the materials allowance request, but in no case be submitted to the Project Engineer later than 30 calendar days following the date of the progress payment report on which the materials allowance was paid.

In case such paid invoices are not furnished within the established time, the materials allowance payment will be removed from the next progress statement and no further materials allowance will be made for that item on that Project.

2. Materials allowances will be paid for those items which are not readily available, and which can be easily identified and secured for a specific project and for which lengthy stockpiling periods would not be detrimental. Some exclusions are as follows:
 - a. No payments will be made on living or perishable plant materials until planted.
 - b. No payments will be made on Portland Cement, Liquid Asphalt, or Grassing Materials.
 - c. No payment will be made for aggregate stockpiled in a quarry. Payment for stockpiled aggregate will be made only if the aggregate is stockpiled on or in the immediate vicinity of the project and is held for the exclusive use on that project. The aggregate must be properly secured. If the aggregate stockpiled is to be paid for per-ton (megagram) it must be reweighed on approved scales at the time it is incorporated into the Project.
 - d. No payments will be made on minor material items, hardware, etc.
3. No materials allowance will be made for materials when it is anticipated that those materials will be incorporated into the Work within 30 calendar days.
4. No materials allowance will be made for a material when the requested allowance for such material is less than \$25,000.
5. Where a storage area is used for more than one project, material for each project shall be segregated from material for other projects, identified, and secured. Adequate access for auditing shall be provided. All units shall be stored in a manner so that they are clearly visible for counting and/or inspection of the individual units.
6. The Commissioner may, at his discretion, grant waiver to the requirements of this Section when, in his opinion, such waiver would be in the public interest.

Subsequently, in the event the material is not on-hand and in the quantities for which the materials allowance was granted, the materials allowance payment will be removed from the next progress statement and no further materials allowance will be made for those items on that Project. If sufficient earnings are not available on the next progress statement, the Contractor agrees to allow the Department to recover the monies from any other Contract he may have with the Department, or to otherwise reimburse the Department.

Payments for materials on hand shall not exceed the invoice price or 75 percent of the bid prices for the pay items into which the materials are to be incorporated, whichever is less.

C. Minimum Payment

No partial payment will be made unless the amount of payment is at least \$1000.00.

D. Liquidated Damages

Accrued liquidated damages will be deducted in accordance with [Subsection 108.08](#).

E. Other Deductions

In addition to the deductions provided for above, the Department has the right to withhold any payments due the Contractor for items unpaid by the Contractor for which the Department is directly responsible, including, but not limited to, royalties (see [Section 106](#)).

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F. Amount of Payment

The balance remaining after all deductions provided for herein have been made will be paid to the Contractor. Partial estimates are approximate and are subject to correction on subsequent progress statements. If sufficient earnings are not available on the subsequent progress statement, the Contractor agrees to allow the Department to recover the monies from any other Contract he may have with the Department, or to otherwise reimburse the Department. The Engineer is responsible for computing the amounts of all deductions herein specified, for determining the progress of the Work and for the items and amounts due to the Contractor during the progress of the Work and for the final statement when all Work has been completed.

G. Interest

Under no circumstances will any interest accrue or be payable on any sums withheld or deducted by the Department as authorized by [Subsection 109.07.A](#), [Subsection 109.07.B.6](#), [Subsection 109.07.C](#), [Subsection 109.07.D](#), [Subsection 109.07.E](#), and [Subsection 109.07.F](#).

H. Insert the Following in Each Subcontract

The Contractor shall insert the following in each Subcontract entered into for work under this Contract:

“The Contractor shall not withhold any retainage on Subcontractors. The Contractor shall pay the Subcontractor 100% percent of the gross value of the Completed Work by the Subcontractor as indicated by the current estimate certified by the Engineer for payment.”

Neither the inclusion of this Specification in the Contract between the Department and the Prime Contractor nor the inclusion of the provisions of this Specification in any Contract between the Prime Contractor and any of his Subcontractors nor any other Specification or Provision in the Contract between the Department and the Prime Contractor shall create, or be deemed to create, any relationship, contractual or otherwise, between the Department and any Subcontractor.

109.08 Final Payment

When Final Inspection and Final Acceptance have been made by the Engineer as provided in [Subsection 105.16](#), the Engineer will prepare the Final Statement of the quantities of the various classes of work performed. All prior partial estimates and payments shall be subject to correction in the Final Statement. The District Engineer will transmit a copy of the Statement to the Contractor by Registered or Certified Mail. The Contractor will be afforded 20 days in which to review the Final Statement in the District Office before it is certified for payment by the Engineer. Any adjustments will be resolved by the District Engineer or in case of a dispute referred to the Chief Engineer whose decision shall be final and conclusive. After approval of the Final Statement by the Contractor, or after the expiration of the 20 days, or after a final ruling on disputed items by the Chief Engineer, the Final Statement shall be certified to the Treasurer by the Chief Engineer stating the Project has been accepted and that the quantities and amounts of money shown thereon are correct, due and payable.

The Treasurer, upon receipt of the Engineer’s certification, shall in turn furnish the Contractor with the Department’s Standard Release Form to be executed in duplicate. The aforesaid Release Form, showing the total amount of money due the Contractor, shall be sent to the Contractor by Registered or Certified Mail, to be delivered to such Contractor upon the signing of a return receipt card, to be returned to the Department in accordance with the provision of Federal law in respect to such matters and such return receipt card shall be conclusive evidence of a tender of said sum of money to the Contractor. Upon receipt of the properly executed Standard Release Form, the Treasurer shall make final payment jointly to the Contractor and his Surety. The aforesaid certification, executed release form, and final payment shall be evidence that the Commissioner, the Engineer, and the Department have fulfilled the terms of the Contract, and that the Contractor has fulfilled the terms of the Contract except as set forth in his Contract Bond.

The Standard Release Form is to be executed by the Contractor within 120 days after delivery thereof, as evidenced by the Registered or Certified Mail Return Receipt. Should the Contractor fail to execute the Standard Release Form because he disputes the Final Payment as offered, or because he believes he has a claim for damages or additional compensation under the Contract, the Contractor shall, within 120 days after delivery to the Contractor of the Standard Release Form, as evidenced by the Registered or Certified Mail Return Receipt, enter suit in the proper court for adjudication of his claim. Should the Contractor fail to enter suit within the aforesaid 120 days, then by agreement hereby stipulated, he is forever barred and stopped from any recovery or claim whatsoever under the terms of this Contract.

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Should the Contractor fail to execute the Standard Release Form or file suit within 120 days after delivery thereof, then the Surety on the Contractor's Bond is hereby constituted the attorney-in-fact of the Contractor for the purpose of executing such final releases as may be required by the Department, including but not limited to the Standard Release Form, and for the purpose of receiving the Final Payment under this Contract.

The Department reserves the right as defined in [Subsection 107.20](#), should an error be discovered in any estimates, to claim and recover from the Contractor or his Surety, or both, such sums as may be sufficient to correct any error of overpayment. Such overpayment may be recovered from payments due on current active Projects or from any future State work done by the Contractor.

The foregoing provisions of this Section shall be applicable both to the Contractor and the Surety on his Bond; and, in this respect, the Surety shall be bound by the provisions of [Subsection 108.09](#) of these Specifications in the same way and manner as the Contractor.

A. Interest

In the event the Contractor fails to execute the *Standard Release Form* as prepared by the Treasurer because he disputes the amount of the final payment as stated therein, the amount due the Contractor shall be deemed by the Contractor and the Department to be an unliquidated sum and no interest shall accrue or be payable on the sum finally determined to be due to the Contractor for any period prior to final determination of such sum, whether such determination be by agreement of the Contractor and the Department or by final judgement of the proper court in the event of litigation between the Department and the Contractor. The Contractor specifically waives and renounces any and all rights it may have under Section 13-6-13 of the Official Code of Georgia and agrees that in the event suit is brought by the Contractor against the Department for any sum claimed by the Contractor under the Contract, for delay damages resulting from a breach of contract, for any breach of contract or for any extra or additional work, no interest shall be awarded on any sum found to be due from the Department to the Contractor in the final judgement entered in such suit. All final judgements shall draw interest at the legal rate, as specified by law. Also, the Contractor agrees that notwithstanding any provision or provisions of Chapter 11 of Title 13 of the Official Code of Georgia that the provisions of this contract control as to when and how the Contractor shall be paid for The Work. Further, the Contractor waives and renounces any and all rights it may have under Chapter 11 of Title 13 of the Official Code of Georgia.

B. Termination of Department's Liability

Final payment will be in the amount determined by the statement as due and unpaid. The acceptance of the final payment or execution of the Standard Release Form or failure of the Contractor to act within 120 days as provided herein after tender of payment, or final payment to the Contractor's Surety in accordance with the provisions stipulated herein, shall operate as and be a release to the Department, the Commissioner, and the Engineer from all claims of liability under this contract and for any act or neglect of the Department, the Commissioner, or the Engineer.

109.09 Termination Clause

A. General

The Department may, by written notice, terminate the Contract or a portion thereof for the Department's convenience when the Department determines that the termination is in the State's best interest, or when the Contractor is prevented from proceeding with the Contract as a direct result of one of the following conditions:

1. An Executive Order of the President of the United States with respect to the prosecution of war or in the interest of national defense.
2. The Engineer and Contractor each make a determination, that, due to a shortage of critical materials required to complete the Work which is caused by allocation of these materials to work of a higher priority by the Federal Government or any agency thereof, it will be impossible to obtain these materials within a practical time limit and that it would be in the public interest to discontinue construction.
3. An injunction is imposed by a court of competent jurisdiction which stops the Contractor from proceeding with the Work and causes a delay of such duration that it is in the public interest to terminate the Contract and the Contractor was not at fault in creating the condition which led to the court's injunction.

The decision of the Engineer as to what is in the public interest and as to the Contractor's fault, for the purpose of Termination, shall be final.

4. Orders from duly constituted authority relating to energy conservation.

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B. Implementation

When, under any of the conditions set out in Subsection A of this Section, the Contract, or any portion thereof, is terminated before completion of all Items of Work in the Contract, the Contractor shall be eligible to receive some or all of the following items of payment:

1. For the actual number of units of Items of Work completed, payment will be made at the Contract Unit Price.
2. Reimbursement for organization of the Work and moving equipment to and from the job will be considered where the volume of work completed is too small to compensate the Contractor for these expenses under the Contract Unit Prices. However, the Engineer's decision as whether or not to reimburse for organization of the Work and moving equipment to and from the job, and in what amount, shall be final.
3. Acceptable materials, obtained by the Contractor for the Work, that have been inspected, tested, and accepted by the Engineer, and that are not incorporated in the Work will, at the request of the Contractor, be purchased from the Contractor at actual cost as shown by receipted bills and actual cost records at such points of delivery as may be designated by the Engineer. This will include any materials that have been delivered to the project site or that have been specifically fabricated for the project and are not readily usable on other projects. It will not include materials that may have been ordered, but not delivered to the project site and that are readily usable on other projects (e.g., guard rail, stone, lumber, etc.).
4. For Items of Work partially completed, payment adjustments including payments to afford the Contractor a reasonable profit on work performed, may be made as determined by the Engineer based upon a consideration of costs actually incurred by the Contractor in attempting to perform the Contract.
5. No payment will be made, and the Department will have no liability, for lost profits on Work not performed. In particular, the Department will not be liable to the Contractor for all profits the Contractor expected to realize had the Project been completed, nor for any loss of business opportunities, nor for any other consequential damages.
6. In order that the Department may make a determination of what sums are payable hereunder, the Contractor agrees that, upon termination of the Contract, it will make all of its books and records available for inspection and auditing by the Department.

To be eligible for payment, costs must have been actually incurred, and must have been recorded and accounted for according to generally accepted accounting principles, and must be items properly payable under Department policies. Where actual equipment costs cannot be established by the auditors, payment for unreimbursed equipment costs will be made in the same manner as is provided in [Subsection 109.05](#) for Force Account Work. Idle time for equipment shall be reimbursed at standby rates. In no case will the Contractor be reimbursed for idle equipment after the Engineer has advised the Contractor the equipment is no longer needed on the job. Refusal of the Contractor to allow the Department to inspect and audit all of the Contractor's books and records shall conclusively establish that the Department has no liability to the Contractor for any payment under this provision, and shall constitute a waiver by the Contractor of any claim for damages allegedly caused by breach or termination of the Contract. The amount payable under this provision, if any, is to be determined by the Engineer, whose determination will be final and binding.

7. The sums payable under this Subsection shall be the Contractor's sole and exclusive remedy for termination of the Contract.

C. Termination of a Contract

Termination of a Contract or a portion thereof shall not relieve the Contractor of his responsibilities for any completed portion of the Work, nor shall it relieve his Surety of its obligation for and concerning any just claims arising out of the Work performed.

109.10 Interest

In the event any lawsuit is filed against the Department alleging the Contractor is due additional money because of claims or for any breach of contract, the Contractor hereby waives and renounces any right it may have under O.C.G.A. Section 13-6-13 to prejudgment interest. Also, the Contractor agrees that notwithstanding any provision or provisions of Chapter 11 of Title 13 of the Official Code of Georgia that the provisions of this contract control as to when and how the Contractor shall be paid for The Work. Further, the Contractor waives and renounces any and all rights it may have under Chapter 11 of Title 13 of the Official Code of Georgia.

109.11 Price Adjustments

A. Asphalt Cement Price Adjustments will be computed on a *monthly* basis in accordance with the following:

PA = Price Adjustment.

APM= the “Monthly Asphalt Cement Price (Georgia Base Asphalt Price)” for the month the hot mix asphalt/bituminous tack/bituminous surface treatment is placed.

APL = the “Monthly Asphalt Cement Price (Georgia Base Asphalt Price)” for the month which the project was let.

TMT = Total Monthly Tonnage of asphalt cement computed by the Engineer based on the Hot Mix Asphaltic Concrete of the various types per ton (megagram)//Total Monthly Tonnage of asphalt cement used for bituminous tack coat (asphalt cement tack coat only, emulsified bituminous materials for tack coat are excluded) converted from gallons to tons (megagrams) by the Engineer//Total Monthly Tonnage of asphalt cement used for bituminous surface treatment (total gallons of asphalt emulsion used, as measured from distributors, will be multiplied by a factor of 0.65 to determine the quantity in gallons of asphalt cement used) converted from gallons to tons (megagrams) by the Engineer and certified for payment.

- a. If the asphalt cement price for the month is *greater* than the asphalt cement price for the month in which the project was let to contract, the contractor will be paid an amount calculated in accordance with the following formula:

$$PA = [((APM-APL)/APL)] \times TMT \times APL$$

- b. If the asphalt cement price for the month is *less* than the asphalt cement price for the month in which the project was let to contract, the Department will deduct an amount calculated in accordance with the following formula:

$$PA = [((APM-APL)/APL)] \times TMT \times APL$$

1. **“Monthly Asphalt Cement Price”**: The Department will determine the “Monthly Asphalt Cement Price” based on the following formulas:

Monthly Asphalt Cement Price = 100% Georgia Base Asphalt Price;

Where;

GBAP = “Georgia Base Asphalt Price”, (in dollars/ton) is based on the arithmetic average posted price of PG asphalt cement as specified in Section 820, from the Department’s monthly survey obtained from approved asphalt cement suppliers of bituminous materials to the Department projects F.O.B. the suppliers terminal. However, the highest price and the lowest price are excluded from the calculation of price, GBAP.

2. **“Asphalt Cement Quantity Calculation”**: The calculation of asphalt cement quantity for each mix type will be based on the asphalt cement content (AC %) of the approved Job Mix Formula (JMF) as specified in Subsection 400.1.03.C. The following calculation formula will be used to determine asphalt cement quantity:

Asphalt Cement Quantity = Hot Mix Asphaltic Concrete monthly total in tons (megagrams) per mix type certified for the payment x AC (%)

Section 109—Measurement and Payment

The Total Monthly Tonnage (TMT) of asphalt cement computed by the Engineer will be calculated as follows:

TMT = Sum of all asphalt cement quantities, including polymer modified asphalt binder and non-modified asphalt cement, based on the Hot Mix Asphaltic Concrete of the various mix types per ton (megagram)// Sum of all asphalt cement quantities used as bituminous tack coat converted from gallons to tons (megagrams)// Sum of all asphalt cement quantities used for bituminous surface treatment (total gallons of asphalt emulsion used, as measured from distributors, will be multiplied by a factor of 0.65 to determine the quantity in gallons of asphalt cement used) converted from gallons to tons (megagrams) by the Engineer certified for payment.

Asphalt Cement Price for the Month (APM) will be adjusted monthly. Price adjustments (PA) will be made monthly and all calculations for Price Adjustments shall be performed by the Engineer as specified in SOP-39 “Determination of Asphalt Cement Index and Asphalt Cement Price Adjustment”.

- B. Price Adjustment Trigger:** No price adjustment will be made on any project with less than 366 Calendar Days from the Contract Letting Date to the specified completion date. If the original Contract contains 366 Calendar Days or more, the Price Adjustment shall be made on quantities placed from the Contract Letting Date to the specified completion date.
- C. “Monthly Asphalt Cement Price”:** The Department will publish a “Monthly Asphalt Cement Price” based on the formula contained within this specification.
- D. “Other Restrictions”:**
 - 1. No asphalt cement price adjustment will be made for cut-back, and emulsified asphalt when used for bituminous tack coat with Hot Mix Asphaltic Concrete Construction.
 - 2. There is a cap of 60% above the FPL/APL for any price adjustment.
 - 3. Unless specifically provided for by Supplemental Agreement or Contract Amendment, no positive Price Adjustments Asphalt Cement that result in a payment to the Contractor will be made after the original Contract Time has expired. Irrespective of any other provisions in the Contract, for purposes of this specification, “Contract Time” does not include any time extensions or Supplemental Agreements which affect the completion of the Contract. Negative Price Adjustments for Asphalt Cement for any work placed after the original Contract Time expires resulting in a return of funds to the Department will be made and shall be computed based on the Monthly Asphalt Cement Price at the time the Contract Time has expired or the Monthly Asphalt Cement Price at the time the Contract was let, whichever is less.
- E. Final Adjustment:** If there are differences between the final audited quantities and the sum of the quantities used to determine the fuel/asphalt cement adjustment, the Engineer will make a pro-rated increase or decrease in the price adjustment.

Payment for Fuel Price Adjustment will be made under:

Item No. 109	Price Adjustment- Asphalt Cement	\$ (+/-)
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**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA**

SPECIAL PROVISION

Section 149 – Construction Layout

Delete Subsection 149.3.05.I and substitute the following:

I. Maintain the Stakes

After construction has begun in any segment of the Project, maintain the stakes that identify construction station numbers and locations as follows:

1. Ensure that stakes are placed at intervals not to exceed 200 ft (60 m) and use even, 100 ft (30 m) stations. On asphalt shoulder widening and earth shoulder reconstruction projects use mile post numbers when stations are not used.
Mark and flag stakes so that they are visible to DOT Project personnel in that segment of the Project until construction is complete.
Projects utilizing GPS controlled fine grading equipment, place stakes at intervals not to exceed 300 ft (91 m) on English projects and 100 m (310 ft) on metric projects. Use even, 100 ft (30 m) or 100 m (310 ft), stations.
2. During grading activities in fills or cuts over 20 ft (6 m), extend slope stakes up or down the slopes in intervals of 10 ft (3 m) or less to achieve an accurate cross section.
3. Denote the offset distance to the construction centerline on the station number stakes, when the station number is maintained in a location other than on the construction centerline. On asphalt shoulder widening and earth shoulder reconstruction projects use the offset to the edge of pavement on the stakes.

Office of Materials & Research

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA**

SPECIAL PROVISION

Section 150—Traffic Control

150.01 GENERAL

This section as supplemented by the Plans, Specifications, and Manual on Uniform Traffic Control Devices (MUTCD) shall be considered the Temporary Traffic Control (TTC) Plan. Activities shall consist of furnishing, installing, maintaining, and removing necessary traffic signs, pedestrian signs, barricades, lights, signals, cones, pavement markings and other traffic control devices and shall include flagging and other means for guidance and protection of vehicular and pedestrian traffic through the Work Zone. This Work shall include both maintaining existing devices and installing additional devices as necessary in construction work zones.

When any provisions of this Specification or the Plans do not meet the minimum requirements of the MUTCD, the MUTCD shall control. The 2009 Edition of the MUTCD shall be in effect for the duration of the project.

The needs and control of all road users (motorists, bicyclists and pedestrians within the highway right-of-way and easements, including persons with disabilities in accordance with the Americans with Disabilities Act of 1990 (ADA), Title II, Paragraph 35.130) through a Temporary Traffic Control (TTC) zone shall be an essential part of highway construction, utility work, maintenance operations and management of traffic incidents.

The Worksite Traffic Control Supervisor (WTCS) shall have a copy of Part VI of the MUTCD and the Contract on the job site. Copies of the current MUTCD may be obtained from the FHWA web page at <http://mutcd.fhwa.dot.gov>.

A. WORKER SAFETY APPAREL

All workers, including emergency responders, within the right-of-way who are exposed either to traffic (vehicles using the highway for purpose of travel) or to work vehicles and construction equipment within the TTC zone shall wear high-visibility safety apparel that meets the Performance Class 2 or 3 requirements of the ANSI/ISEA 107-2004 publication entitled "American National Standard for High-Visibility Safety Apparel and Headwear", or equivalent revisions, and labeled as meeting the ANSI 107-2004 standard performance for Class 2 or 3 risk exposure. Emergency and incident responders and law enforcement personnel within the TTC zone may wear high-visibility safety apparel that meets the performance requirements of the ANSI/ISEA 207-2006 publication entitled "American National Standard for High-Visibility Public Safety Vests", or equivalent revisions, and

labeled as ANSI 207-2006, in lieu of ANSI/ISEA 107-2004 apparel. Firefighters or other emergency responders working within the right-of-way and engaged in emergency operations that directly expose them to flame, fire, heat, and/or hazardous material may wear retroreflective turn-out gear that is specified and regulated by other organizations, such as the National Fire Protection Association.

B. WORKSITE TRAFFIC CONTROL SUPERVISOR

ALL HIGHWAYS (ADDITIONAL REQUIREMENTS BELOW FOR INTERSTATES): The Contractor shall designate a qualified individual as the Worksite Traffic Control Supervisor (WTCS) who shall be responsible for selecting, installing and maintaining all traffic control devices in accordance with the Plans, Specifications, Special Provisions and the MUTCD. A written resume documenting the experience and credentials of the WTCS shall be submitted and accepted by the Engineer prior to beginning any work that involves traffic control. The WTCS shall be available on a twenty-four (24) hour basis to perform his duties. If the work requires traffic control activities to be performed during the daylight and nighttime hours it may be necessary for the Contractor to designate an alternate WTCS. An alternate WTCS must meet the same requirements and qualifications as the primary WTCS and be accepted by the Engineer prior to beginning any traffic control duties. The Worksite Traffic Control Supervisor's traffic control responsibilities shall have priority over all other assigned duties.

As the representative of the Contractor, the WTCS shall have full authority to act on behalf of the Contractor in administering the TTC Plan. The WTCS shall have appropriate training in safe traffic control practices in accordance with Part VI of the MUTCD. In addition to the WTCS all other individuals making decisions regarding traffic control shall meet the training requirements of the Part VI of the MUTCD.

The WTCS shall supervise the initial installation of traffic control devices. The Engineer prior to the beginning of construction will review the initial installation. Modifications to traffic control devices as required by sequence of operations or staged construction shall be reviewed by the WTCS.

The WTCS shall be available on a full-time basis to maintain traffic control devices with access to all personnel, materials, and equipment necessary to respond effectively to an emergency situation within forty-five (45) minutes of notification of the emergency.

The WTCS shall regularly perform inspections to ensure that traffic control is maintained. Unless modified by the special conditions or by the Engineer, routine deficiencies shall be corrected within a twenty-four (24) hour period. Failure to comply with these provisions shall be grounds for dismissal from the duties of WTCS and/or removal of the WTCS from the project. Failure of the WTCS to execute his duties shall be considered as non-performance under [Subsection 150.08](#).

The Engineer will periodically review the work for compliance with the requirements of the TTC plan.

On projects where traffic control duties will not require full time supervision, the Engineer may allow the Contractor's Project Superintendent to serve as the WTCS as long as satisfactory results are obtained.

CERTIFIED WORKSITE TRAFFIC CONTROL SUPERVISOR

ADDITIONAL REQUIREMENTS FOR INTERSTATE AND LIMITED ACCESS HIGHWAYS: In addition to the requirements above, the WTCS shall have a minimum of one year's experience directly related to work site traffic control in a supervisory or responsible capacity. The WTCS shall be currently certified by the American Traffic Safety Services Association (ATSSA) Work Site Traffic Supervisor Certification program or the National Safety Council Certification program.

Any work performed on the interstate or limited access highway right-of-way that requires traffic control shall be supervised by the Certified Worksite Traffic Control Supervisor. No work requiring traffic control shall be performed unless the certified WTCS is on the worksite. Failure to maintain a Certified Worksite Traffic Control Supervisor on the work will be considered as non-performance under Subsection 150.08.

The WTCS shall perform, as a minimum, weekly traffic control inspections on all interstate and limited access highways. The inspection shall be reported to the Engineer on a TC-1 report. The Engineer will furnish a blank copy of the TC-1 report to the Contractor prior to the beginning of any work on the interstate or limited access right-of-way.

C. TRAFFIC CONTROL DEVICES

All traffic control devices used during the construction of a project shall meet the Standards utilized in the MUTCD, and shall comply with the requirements of these Specifications, Project Plans, and Special Provisions. All devices shall be tested at NCHRP Test Level III. Reference is made to [Subsections 104.05](#), [107.07](#), and [107.09](#).

D. REFLECTORIZATION REQUIREMENTS

All rigid fluorescent orange construction warning signs (black on fluorescent orange) shall meet the reflectorization and color requirements of ASTM Type VII, VIII, IX or X regardless of the mounting height.

Portable signs which have flexible sign blanks shall meet the reflectorization and color requirements of ASTM Type VI.

Warning signs (W3-1a) for stop conditions that have rumble strips located in the travelway shall be reflectorized with ASTM Type IX fluorescent yellow sheeting.

All other signs shall meet the requirements of ASTM Type III or IV except for "Pass With Care" and "Do Not Pass" signs which may be ASTM Type I unless otherwise specified.

CHANNELIZATION DEVICES: Channelization devices shall meet the requirements of ASTM Type III or IV high intensity sheeting.

E. IMPLEMENTATION REQUIREMENTS

No work shall be started on any project phase until the appropriate traffic control devices have been placed in accordance with the Project requirements. Changes to traffic flow shall not commence unless all labor, materials, and equipment necessary to make the changes are available on the Project.

When any shift or change is made to the location of traffic or to the flow patterns of traffic, including pedestrian traffic, the permanent safety features shall be installed and fully operational before making the change. If staging or site conditions prevent the installation of permanent features then the equivalent interim devices shall be utilized. This work shall also include any necessary removal and reinstallation of guardrail panels to achieve the required panel lap to accommodate the appropriate shift and traffic flow including the final traffic flow configuration (The cost of performing this work shall be included in Traffic Control-Lump Sum).

Any section of the work that is on new location shall have all permanent safety features installed and fully operational before the work is opened to traffic. Safety features shall include but are not limited to the following items:

1. Guardrail including anchors and delineation with properly lapped panels
2. Impact attenuators
3. Traffic signals
4. Warning devices
5. Pavement markings including words, symbols, stop bars, and crosswalks
6. Roadway signs including regulatory, warning, and guide

Outdoor lighting shall be considered as a safety feature for welcome centers, rest areas, and weigh station projects. For typical roadway type projects new street lighting is not considered a safety feature unless specifically noted in the plans or in the special conditions.

F. MAINTENANCE OF TRAFFIC CONTROL DEVICES

Traffic control devices shall be in acceptable condition when first erected on the project and shall be maintained in accordance with [Subsection 104.05](#) throughout the construction period. All unacceptable traffic control devices shall be replaced within 24 hours. When not in use, all traffic control devices shall be removed, placed or covered so as not to be visible to traffic. All construction warning signs shall be removed within seven calendar days after time charges are stopped or pay items are complete. If traffic control devices are left in place for more than ten days after completion of the Work, the Department shall have the right to remove such devices, claim possession thereof, and deduct the cost of such removal from any monies due, or which may become due, the Contractor.

G. TRAFFIC INTERRUPTION RESTRICTIONS

The Department reserves the right to restrict construction operations when, in the opinion of the Engineer, the continuance of the Work would seriously hinder traffic flow, be needlessly disruptive or unnecessarily inconvenience the traveling public. The Contractor shall suspend and/or reschedule any work when the Engineer deems that conditions are unfavorable for continuing the Work.

Advanced notification requirements to the Contractor to suspend work will be according to the events and the time restrictions outlined below:

Incident management	No advanced notice required
Threatening/Inclement weather	24 hours
Holidays, sporting events, unfavorable conditions	Three (3) calendar days

If the work is suspended, the Contractor may submit a request for additional contract time as allowed under Section 108. The Department will review the request and may grant additional contract time as justified by the impact to the Contractor's schedule. Compensation for loss of productivity, rescheduling of crews, rental of equipment or delays to the Contractor's schedule will not be considered for payment. Additional contract time will be the only consideration granted to the Contractor.

H. SEQUENCE OF OPERATIONS

Any Sequence of Operations provided in this Contract in conjunction with any staging details which may be shown in the plans, is a suggested sequence for performing the Work. It is intended as a general staging plan for the orderly execution of the work while minimizing the impact on pedestrian facilities, mainline, cross-streets and side streets. The Contractor shall develop detailed staging and temporary traffic control plans for performing specific areas of the Work including but not limited to all traffic shifts, detours, bridge widenings, paces, or other activities that disrupt traffic or pedestrian flow. The Engineer may require detailed staging and TTC plans for lane closures or disruption to pedestrian facilities. These plans shall be submitted for approval at least two weeks prior to the scheduled date of the activity. Activities that have not been approved at least seven (7) days prior to the scheduled date shall be rescheduled.

Where traffic is permitted through the work area under stage construction, the Contractor may choose to construct, at no additional expense to the Department, temporary on-site bypasses or detours in order to expedite the work. Plans for such temporary bypasses or detours shall be submitted to the Engineer for review and approval 30 calendar days prior to the proposed construction. Such bypasses or detours shall be removed promptly when in the opinion of the Engineer; they are not longer necessary for the satisfactory progress of the Work. Bypasses and detours shall meet the minimum requirements of [Section 150.02.B.4](#).

As an option to the Sequence of Operations in the Contract, the Contractor may submit an alternative Sequence of Operations for review and approval. Alternate Sequence of Operations for pedestrian facilities shall be in compliance with the MUTCD and ADA. Pedestrian needs identified in the preconstruction phase shall be included in the proposed alternate plan. The Department may consider the Contractor's alternate Sequence of Operations as a Value Engineering Proposal as defined by [Section 104.08](#). A twenty calendar days lead time for the Department's review shall be given to this submission so that a decision on its acceptability can be made and presented at the Preconstruction Conference. Insufficient lead time or no submission by the Contractor shall be construed

as acceptance of the Sequence of Operations outlined in the Contract and the willingness of the Contractor to execute this as-bid plan.

The Department will not pay, or in any way reimburse the Contractor for claims arising from the Contractor's inability to perform the Work in accordance with the Sequence of Operations provided in the Contract or from an approved Contractor alternate.

The Contractor shall secure the Engineer's approval of the Contractor's proposed plan of operation, sequence of work and methods of providing for the safe passage of vehicular and pedestrian traffic before it is placed in operation. The proposed plan of operation shall supplement the approved traffic control plan. Any major changes to the approved TTC plan, proposed by the Contractor, shall be submitted to the Department for approval.

Some additional traffic control details will be required prior to any major shifts or changes in traffic. The traffic control details shall include, but not be limited to, the following:

1. A detailed drawing showing traffic locations and laneage for each step of the change.
2. The location, size, and message of all signs required by the MUTCD, Plan, Special Provisions, and other signs as required to fit conditions. Any portable changeable message signs used shall be included in the details.
3. The method to be used in, and the limits of, the obliteration of conflicting lines and markings.
4. Type, location, and extent of new lines and markings.
5. Horizontal and vertical alignment and superelevation rates for detours, including cross-section and profile grades along each edge of existing pavement.
6. Drainage details for temporary and permanent alignments.
7. Location, length, and/or spacing of channelization and protective devices (temporary barrier, guardrail, barricades, etc.)
8. Starting time, duration and date of planned change.
9. For each traffic shift, a paving plan, erection plan, or work site plan, as appropriate, detailing workforce, materials, and equipment necessary to accomplish the proposed work. This will be the minimum resource allocation required in order to start the work.

A minimum of three copies of the above details shall be submitted to the Engineer for approval at least 14 days prior to the anticipated traffic shift. The Contractor shall have traffic control details for a traffic shift which has been approved by the Engineer prior to commencement of the physical shift. All preparatory work relative to the traffic shift, which does not interfere with traffic, shall be accomplished prior to the designated starting time. The Engineer and the Contractor's representative will verify that all conditions have been met prior to the Contractor obtaining materials for the actual traffic shift.

150.02 TEMPORARY TRAFFIC CONTROL (TTC) ZONES:

A. DEVICES AND MATERIALS:

In addition to the other provisions contained herein, work zone traffic control shall be accomplished using the following means and materials:

1. Portable Advance Warning Signs

Portable advance warning signs shall be utilized as per the requirements of the temporary traffic control plans. All signs shall meet the requirements of the MUTCD and shall be NCHRP 350 crashworthy compliant.

2. Arrow Panels

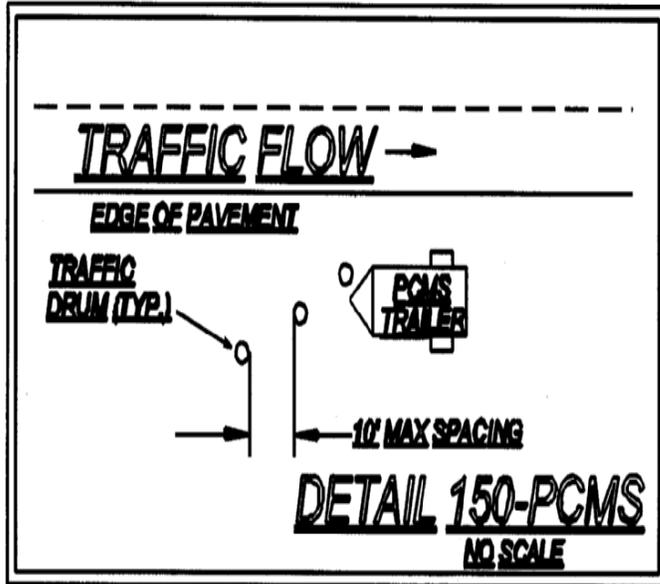
Portable sequential or flashing arrow panels as shown in the Plans or Specifications for use on Interstate or multi-lane highway lane closure only, shall be a minimum size of 48" high by 96" wide with not less than 15 lamps used for the arrow. The arrow shall occupy virtually the entire size of the arrow panel and shall have a minimum legibility distance of one mile. The minimum legibility distance is that distance at which the arrow panel can be comprehended by an observer on a sunny day, or clear night. Arrow panels shall be equipped with automatic dimming features for use during hours of darkness. The arrow panels shall also meet the requirements for a Type C panel as shown in the MUTCD. The sequential or flashing arrow panels shall not be used for lane closure on two-lane, two-way highways when traffic is restricted to one-lane operations in which case, appropriate signing, flaggers and when required, pilot vehicles will be deemed sufficient.

The sequential or flashing arrow panels shall be placed on the shoulder at or near the point where the lane closing transition begins. The panels shall be mounted on a vehicle, trailer, or other suitable support. Vehicle mounted panels shall be provided with remote controls. Minimum mounting height shall be seven feet above the roadway to the bottom of the panel, except on vehicle mounted panels which should be as high as practical.

For emergency situations, arrow display panels that meet the MUTCD requirements for Type A or Type B panels may be used until Type C panels can be located and placed at the site. The use of Type A and Type B panels shall be held to the minimum length of time possible before having the Type C panel(s) in operation. The Engineer shall determine when conditions and circumstances are considered to be emergencies. The Contractor shall notify the Engineer, in writing, when any non-specification arrow display panel(s) is being used in the work.

3. Portable Changeable Message Signs

Portable changeable message signs meeting the requirements of [Section 632](#) and the MUTCD. Any PCMS in use that is not protected by positive barrier protection shall be delineated by a minimum of three drums that meet the requirement of Section 150.05.A.1. The drum spacing shall not exceed a maximum of ten (10') feet as shown in [Detail 150-PCMS](#). When the PCMS is within twenty (20') feet of the opposing traffic flow, the trailing end of the PCMS shall be delineated with a minimum of three drums spaced in the same manner as the approach side of the PCMS.



When not in use the PCMS shall be removed from the roadway unless protected by positive barrier protection. If the PCMS is protected by positive barrier protection the sign panel shall be turned away from traffic when not in use.

4. Channelization Devices

Channelization devices shall meet the standards of the MUTCD and [Subsection 150.05](#).

5. Temporary Barrier

Temporary barrier shall meet the requirements of [Sections 622](#).

6. Temporary Traffic Signals

Temporary traffic signals shall meet the requirements of [Section 647](#) and the MUTCD.

7. Pavement Marking

Pavement marking incorporated into the work shall comply with [Subsections 150.04.A](#) and [150.04.B](#).

8. Portable Temporary Traffic Control Signals

The use of Portable Temporary Traffic Control Signals shall meet the following minimum requirements:

Only two-lane two-way roadways will be allowed to utilize Portable Temporary Traffic Control Signals.

All portable traffic control signals shall meet the physical display and operational requirements of conventional traffic signals described in the MUTCD.

Each signal face shall have at least three lenses. The lenses shall be red, yellow, or green in color and shall give a circular type of indication. All lenses shall be twelve (12") inches nominal in diameter.

A minimum of two signal faces shall face each direction of traffic. A minimum of one signal head shall be suspended over the roadway travel lane in a manner that will allow the bottom of the signal head housing to be not less than seventeen (17') feet above and not more than nineteen (19') feet above the pavement grade at the center of the travel lane. The second signal head may be located over the travel lane with the same height requirements or the second signal head may be located on the shoulder. When the signal head is located on the shoulder the bottom of the signal head housing shall be at least eight (8') feet but not more than (15') feet above the pavement grade at the center of highway.

Advance warning signage and appropriate pavement markings shall be installed as part of the temporary signal operation.

The signals shall be operated in a manner consistent with traffic requirements. The signals may be operated in timed-mode or in a vehicle-actuated mode. The signals shall be interconnected in a manner to ensure that conflicting movements can not occur. To assure that the appropriate operating pattern including timing is displayed to the traveling public, regular inspections including the use of accurate timing devices shall be made by the Worksite Traffic Control Supervisor. If at any time any part of the system fails to operate within these requirements then the use of the signal shall be suspended and the appropriate flagging operation shall begin immediately.

The Worksite Traffic Control Supervisor (WTCS) shall continuously monitor the portable traffic control signal to insure compliance with the requirements for maintenance under the MUTCD. The signal shall be maintained in a manner consistent with the intention of the MUTCD, with emphasis on cleaning of the optical system. Timing changes shall be made only by the WTCS. The WTCS shall keep a written record of all timing changes.

The portable temporary signal shall have two power sources and shall be capable of running for seven calendar days continuously.

The Contractor shall have an alternate temporary traffic control plan in the event of failure of the signal.

9. RUMBLE STRIPS

Rumble strips incorporated into the work shall meet the requirements of [Section 429](#) and the MUTCD. Existing rumble strips that are positioned in the traveled way to warn traffic of a stop condition shall be reinstalled based on the following requirements:

INTERMEDIATE SURFACES: Intermediate surfaces that will be in use for more than forty-five (45) calendar days shall have rumble strips reinstalled on the traveled way in the area of a stop condition. Non-refundable deductions in accordance with [Subsection 150.08](#) will be assessed for any intermediate surface in place for greater than 45 days without rumble strips.

FINAL SURFACES: Rumble strips shall be installed on the final surface within fourteen (14) calendar days of the placement of the final surface in the area of the stop condition. Failure to install within fourteen (14) calendar days will result in assessment of non-refundable deductions in accordance with 150.08.

Prior to the removal of any rumble strips located in the travelway, stop ahead (W3-1a) warning signs shall be double indicated ahead of the stop condition. These warning signs shall be a minimum of 48 inches by 48 inches. The reflectorization of the warning signs shall be as required by [Subsection 150.01.D](#). These warning signs shall remain in place until the rumble strips have been reinstalled on the traveled way. Any existing warning signs for the stop ahead condition shall be removed or covered while the 48" X 48" (W3-1a) signs are in place. When the rumble strips have been reinstalled these warning signs should be promptly removed and any existing signage placed back in service.

10. GUARDRAIL: When the removal and installation of guardrail is required as a part of the work the following time restrictions shall apply unless modified by the special conditions:

MULTI-LANE HIGHWAYS: From the time that the existing guardrail or temporary positive barrier protection is removed the Contractor has fourteen (14) calendar days to install the new guardrail and anchors. During the interim, the location without guardrail shall be protected with drums spaced at a maximum spacing of twenty (20') feet. The maximum length of rail that can be removed at any time without being replaced with positive barrier protection is a total of 2000 linear feet of existing rail or the total length of one run of existing rail, whichever is less.

ALL OTHER HIGHWAYS: From the time that the existing guardrail is removed or from the time that temporary positive barrier protection is removed the Contractor has thirty (30) calendar days to install the new guardrail and anchors. During the interim, the location without guardrail shall be protected with drums spaced at a maximum spacing of twenty (20') feet. The maximum length of rail that can be removed at any time without being replaced with positive barrier protection is a total of 1000 linear feet of existing rail or the total length of one run of existing rail, whichever is less.

Based on existing field conditions, the Engineer may review the work and require that the guardrail be installed earlier than the maximum time allowed above by giving written notification to the Contractor via the TC-1 traffic control report.

ALL HIGHWAYS: The contractor shall install new guardrail such that traffic exposure to fixed objects is minimized. Within the same work day, temporary attenuators, as defined in [Subsection 150.05.B](#), should be installed on the approach to fixed objects that can't be protected with guardrail. Truck mounted attenuators may be used to shield exposed fixed objects for periods not to exceed forty-eight (48) hours. No separate payment will be made for truck mounted attenuators.

When the roadway is open to traffic, guardrail panels shall be lapped to comply with the directional flow of traffic. Should the staging of the work require that the lap of the guardrail be changed, this work shall be completed before the roadway is opened to traffic. The work to change the lap of any guardrail shall be included in Traffic Control-Lump Sum.

Failure to comply with the above time and quantity restrictions shall be considered as non-compliance under Section 150.08.

11. STOP SIGN REGULATED INTERSECTIONS: For intersections that utilize stop sign(s) to control the flow of traffic and to restrict the movement of vehicles, the stop sign(s) shall be maintained for the duration of the work or until such time that the stop condition is eliminated or until an interim or permanent traffic signal can be installed to provide proper traffic control. The traffic signal shall be installed and properly functioning before the removal of the existing stop sign(s) is permitted. If the existing intersection is enhanced traffic control features such as stop bars, double indicated stop signs, oversized signs, advanced warning stop ahead signs, rumble strips on the approaches or flashing beacons located overhead or on the shoulders then these features shall be maintained for the duration of the project or until the permanent traffic control plan has been implemented.

Whenever the staging of the work requires that the traveled-way be relocated or realigned the Contractor shall reinstall all enhanced traffic control features noted above on the newly constructed sections of the work. The cost of relocating the stop bars, stop signs, advanced warning signs, the rumble strips and the flashing beacons shall be included in the price bid for Lump-Sum-Traffic Control unless individual pay items are included in the contract for rumble strips and/or flashing beacons. When pay items are included in the contract for rumble strips or flashing beacons then these items will be paid per each.

When staging requires the relocation or realignment of an existing stop condition it may be necessary to consider the addition of enhanced traffic control features even though none existed at the original location. Horizontal and vertical alignment changes at a new location may have decreased or restricted sight distance or the stop condition may occur sooner than in the previous alignment. If these conditions occur then the Engineer and/or the WTCS should consider additional measures to enhance the motorist's awareness of the changes even though the staging plans may not address enhanced features. Stop signs should be a minimum of 36 inches for interim situations. The use of 48 inch stop signs may be warranted under project specific conditions. Flags may be used on interim/permanent stop signs that are mounted at seven (7') feet in height for a short duration in order to direct additional attention to a new or relocated stop sign(s). Flags should not be used for durations exceeding two weeks unless unusual or site specify conditions warrant a longer period of time. The use of Type "A" flashing red light(s) attached to the stop sign(s) may be appropriate during the same period that the flags are in use to increase attention.

The use of rumble strips and/or portable changeable message signs may be considered. The use of new rumble strips, where none previously existed, shall have the prior approval of District Traffic Operations before being included as part of the temporary traffic control plan. The message(s) displayed on any PCMS shall have the prior approval of the Engineer and the message(s) shall be included as part of the TTC plan for the interim staging.

The placement of any additional interim ground-mounted signs and posts or stop bars shall be considered as incidental to the price bid for Lump Sum-Traffic Control. The installation of rumble strips, flashing beacons or the use of Portable Changeable Message Signs (PCMS) shall be considered as Extra Work unless pay items are included in the contract.

B. WORK ZONE RESTRICTIONS:

1. Interstate

The Contractor shall not simultaneously perform work on both the inside shoulder and outside shoulder on either direction of traffic flow when the Work is within 12 feet of the travel-way, unless such areas are separated by at least one-half mile of distance.

2. Non-Interstate Divided Highways

The Contractor shall not simultaneously perform work on both the inside shoulder and outside shoulder on either direction of traffic flow when the Work is within 12 feet of the travel-way, unless such areas are separated by at least one-half mile distance in rural areas or at least 500 feet of distance in urban areas.

3. Non-Divided Highways

- a. The Contractor shall not simultaneously perform work on opposite sides of the roadway when the work is within 12 feet of the travel-way, unless such areas are separated by at least one-half mile of distance in rural areas or at least 500 feet of distance in urban areas.
- b. On two-lane projects where full width sections of the existing subgrade, base or surfacing are to be removed, and new base, subgrade, or surfacing are to be constructed, the Contractor shall maintain one-lane traffic through the construction area by removing and replacing the undesirable material for half the width of the existing roadway at a time. Replacement shall be made such that paving is completed to the level of the existing pavement in the adjacent lane by the end of the workday or before opening all the roadway to traffic.

4. All Highways:

- a. There shall be no reduction in the total number of available traffic lanes that existed prior to construction except as specifically allowed by the Contract and as approved by the Engineer.
- b. Travelway Clearances: All portions of the work shall maintain the following minimum requirements:

Horizontal: The combined dimensions of the paved shoulder and the roadway surface remaining outside the Work Zone shall be no less than sixteen (16) feet in width at any location.

Vertical: The overhead clearance shall not be reduced to less than fifteen (15) feet at any location.

The restrictions above apply to all shifts, lane closures, on-site detours and off site detours whether shown in the contract or proposed by the Contractor. It shall be the responsibility of the Contractor to verify that these minimum requirements have been met before proceeding with any phase of the Work.

Two-lane two-way roadways may have temporary horizontal restrictions of less than sixteen (16) feet provided a flagger operation for one-way traffic is utilized to restrict access to the work area by over-width loads. The minimum horizontal clearance shall be restored before the flagging operation is removed.

- c. Highway Work Zone: All sections or segments of the roadway under construction or reconstruction shall be signed as a Highway Work Zone except non-state highway two-lane two-way resurfacing projects. Two conditions can be applied to a Highway Work Zone. Condition 1 is when no reduction in the existing speed limit is required. Condition 2 is when worksite conditions require a reduction of the speed limit through the designated Work Zone. Properly marking a Highway Work Zone shall include the following minimum requirements:

- 1. NO REDUCTION IN THE EXISTING POSTED SPEED LIMIT IN HIGHWAY WORK ZONE:

- a) Signage ([Detail 150-HWZ-1](#)) shall be posted at the beginning point of the Highway Work Zone warning the traveling public that increased penalties for speeding violations are in effect. The [HWZ-2](#) sign shall be placed a minimum of six hundred (600') feet in advance of the Highway Work Zone and shall not be placed more than one thousand (1000') feet in advance of the Work Zone. If no speed reduction is required it is recommended that the [HWZ-2](#) be placed at 750 feet from the work area between the ROAD WORK 500 FT. and the ROAD WORK 1000 FT. signs.

[HWZ-2](#) signs shall be placed at intervals not to exceed one mile for the length of the project. [HWZ-2](#) signs should be placed on the mainline after all major intersections except State Routes. State Routes shall be signed as per the requirements for intersecting roadways below.

- b) The existing speed limit shall be posted at the beginning of the Work Zone. Existing Speed Limit signs (R2-1) shall be maintained.
- c) INTERSECTING ROADWAYS: Intersecting state routes shall be signed in advance of each intersection with the Work Zone with a [HWZ-2](#) sign to warn motorists that increased fines are in effect. All other intersecting roadways that enter into a designated Highway Work Zone may be signed in advance of each intersection with the Work Zone. When construction equipment and personnel are present in the intersection on the mainline of a multi-lane roadway, the intersecting side roads shall be signed in advance with [HWZ-2](#) signs. As soon as the work operation clears the intersection the signage may be removed.
- d) Sign [HWZ-3](#) shall be posted at the end of the Highway Work Zone indicating the end of the zone and indicating that increased penalties for speeding violations are no longer in effect.
- e) When a designated Highway Work Zone is no longer necessary all signs shall be removed immediately.

2. REDUCING THE SPEED LIMIT IN A HIGHWAY WORK ZONE:

Highway Work Zone signs shall be posted as required in Condition 1 above.

For limited access (interstate) highways and controlled access multi-lane divided highways the posted speed limit shall be reduced as required below.

Speed Limit signage (R2-1) for the reduced speed limit shall be erected at the beginning of the work zone. Additional signs shall be placed to ensure that the maximum spacing of the reduced speed limit signs shall be no greater than one (1) mile apart. Existing speed limit signs shall be covered or removed. On multi-lane divided highways the speed limit signs shall be double indicated when the reduced speed is in use.

When any one or more of the following conditions exist and the existing speed limit is 65 mph or 70 mph, the speed limit shall be reduced by 10 mph. If the existing speed limit is 60 mph, the speed limit should be reduced by 5 mph. If the existing speed limit is 55 mph or less, the Contractor can only reduce the speed limit with the prior approval of the Engineer. The reduction in the speed limit shall be no greater than 10 mph:

- a) Lane closure(s) of any type and any duration.
- b) The difference in elevation exceeds two inches adjacent to a travel lane as shown in [Subsection 150.06](#), [Detail 150-B](#), [Detail 150-C](#).
- c) Any areas where equipment or workers are within ten feet of a travel lane.
- d) Temporary portable concrete barriers located less than two (2') feet from the traveled way.
- e) As directed by the Engineer for conditions distinctive to this project.

When the above conditions are not present the speed limit shall be immediately returned to the existing posted speed limit. A speed reduction shall not be put in place for the entire length of the project unless conditions warranting the speed reduction are present for the entire project length. All existing speed limit signs within the temporary speed reduction zone shall be covered or removed while the temporary reduction in the speed limit is in effect. All signs shall be erected to comply with the minimum requirements of the MUTCD.

As a minimum the following records shall be kept by the WTCS:

- a) Identify the need for the reduction.
- b) Record the time of the installation and removal of the temporary reduction.
- c) Fully describe the location and limits of the reduced speed zone.
- d) Document any accident that occurs during the time of the reduction.

A copy of the weekly records for reduced speed zones shall be submitted to the Engineer.

Reduced speed zones shall, as a minimum, be signed as per [Detail 150-HWZ-1](#). Interim signs shall meet the requirements of 150.03 D. Additional signs may be necessary to adjust for actual field conditions.

When a pilot vehicle is used on a two-lane two-way roadway the speed limit should not be reduced. For special conditions specific to the work, on two-lane two-way roadways or multi-lane highways, the contractor may reduce the posted speed limit with the prior approval of the Engineer.

5. MILLED SURFACE RESTRICTIONS:

Unless modified by the special conditions, a milled surface on any asphaltic concrete surface shall not be allowed to remain open to traffic for a period of time that exceeds thirty (30) calendar days.

6. INSTALLATION/REMOVAL OF WORK AREA SIGNAGE:

No payment will be made for Traffic Control-Lump Sum until the Work has actually started on the project. The installation of traffic control signage does not qualify as the start of work. Advanced warning signs shall not be installed until the actual beginning of work activities. Any permanent mount height signs installed as the work is preparing to start shall be covered until all signs are installed unless all signs are installed within seven (7) calendar days after beginning installation.

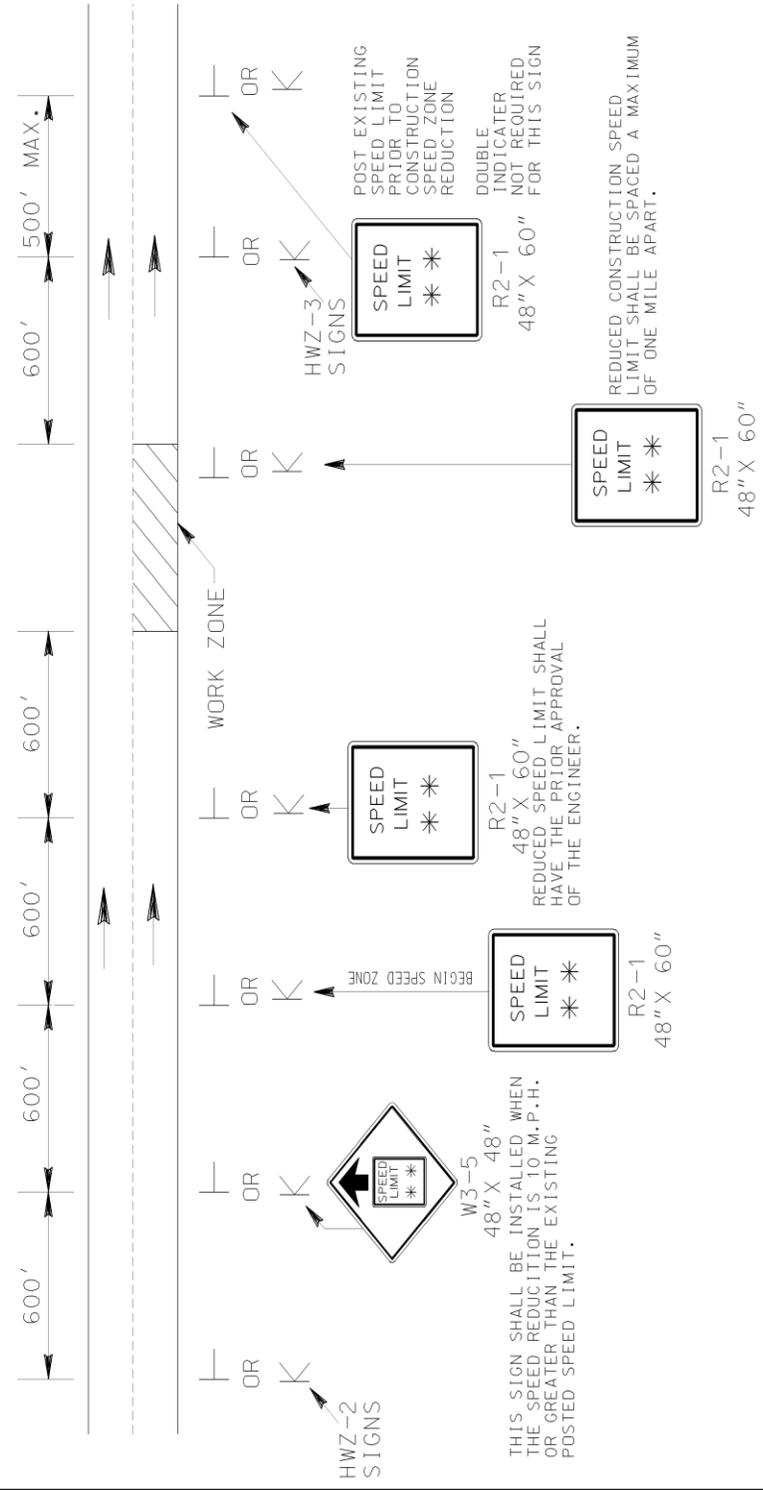
All temporary traffic control devices shall be removed as soon as practical when these devices are no longer needed. When work is suspended for short periods of time, temporary traffic control devices that are no longer appropriate shall be removed or covered.

All construction warning signs shall be removed within seven (7) calendar days after time charges are stopped or pay items are complete. If traffic control devices are left in place for more than ten (10) calendar days after completion of the Work, the Department shall have the right to remove such devices, claim possession thereof, and deduct the cost of such removal from any monies due, or which may become due, the Contractor.

PUNCHLIST WORK: Portable signs shall be utilized to accomplish the completion of all punchlist items. The portable signs shall be removed daily. All permanent mount height signs shall be removed prior to the beginning of the punchlist work except "Low/Soft Shoulder" signs and any signs that have the prior written approval of the Engineer to remain in place while the punchlist work is in progress.

Failure to promptly remove the construction warning signs within the seven (7) calendar days after the completion of the Work or failure to remove or cover signs when work is suspended for short periods of time shall be considered as non-performance under Section 150.08.

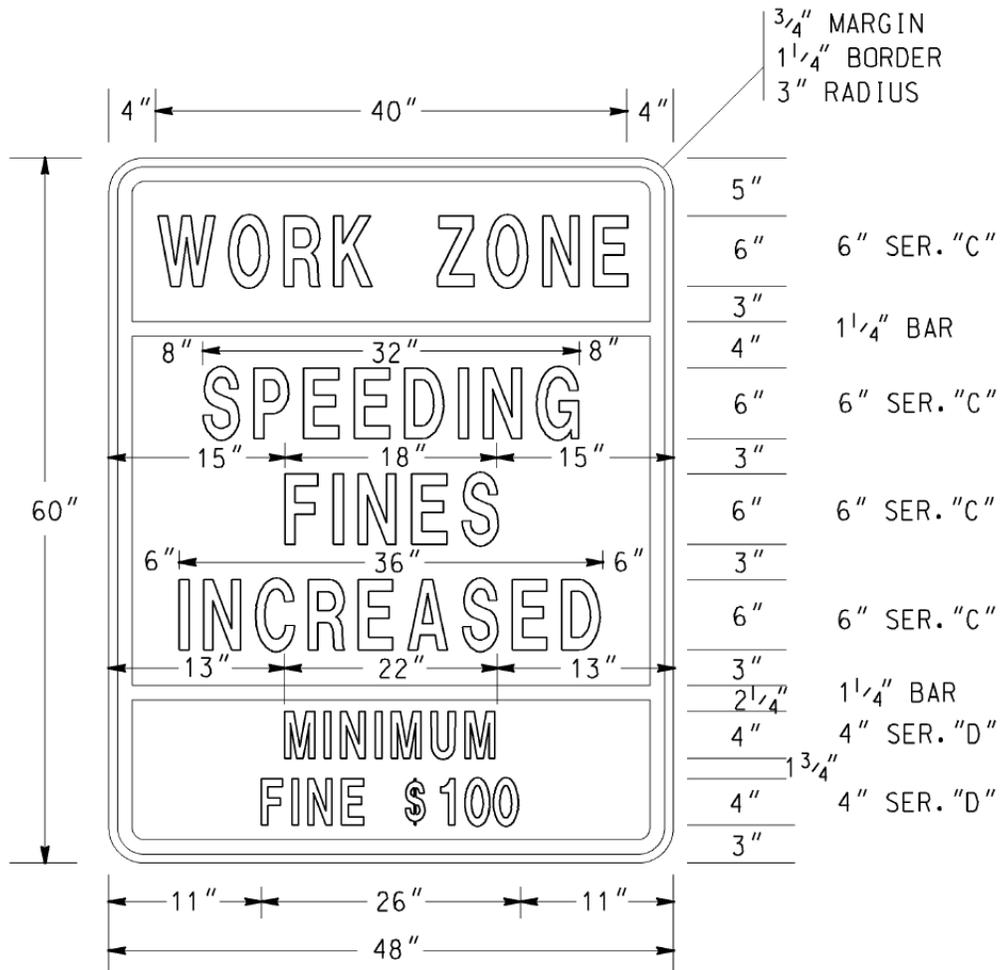
SPEED LIMIT REDUCTION FOR HIGHWAY WORK ZONE
 INTERSTATE AND MULTI-LANE DIVIDED HIGHWAY SIGNING SHALL BE
 DOUBLE INDICATED (RIGHT SHOULDER AND MEDIAN SHOULDER)



ALL INTERSECTING ROADWAYS SHALL BE SIGNED WITH A HWZ-2 SIGN TO WARN MOTORIST ENTERING THE HIGHWAY WORK ZONE.
 INTERSTATE AND MULTI-LANE HIGHWAY SIGNING SHALL BE DOUBLE INDICATED (RIGHT SHOULDER AND MEDIAN SHOULDER).

SIGN SIZES SHOWN ARE FOR INTERSTATE AND MULTI-LANE DIVIDED HIGHWAY. FOR OTHER HIGHWAYS USE STANDARD SIZE SIGNS AS PER THE M.U.T.C.D. EXCEPT HWZ-2 AND HWZ-3 SIGNS.

DETAIL I50-HWZ-1



HWZ-2

COLORS

TOP PANEL

LEGEND & BORDER - BLACK (NON-REFL)

BACKGROUND - FLUORESENT ORANGE

(ASTM TYPE VII, VIII, IX or X)

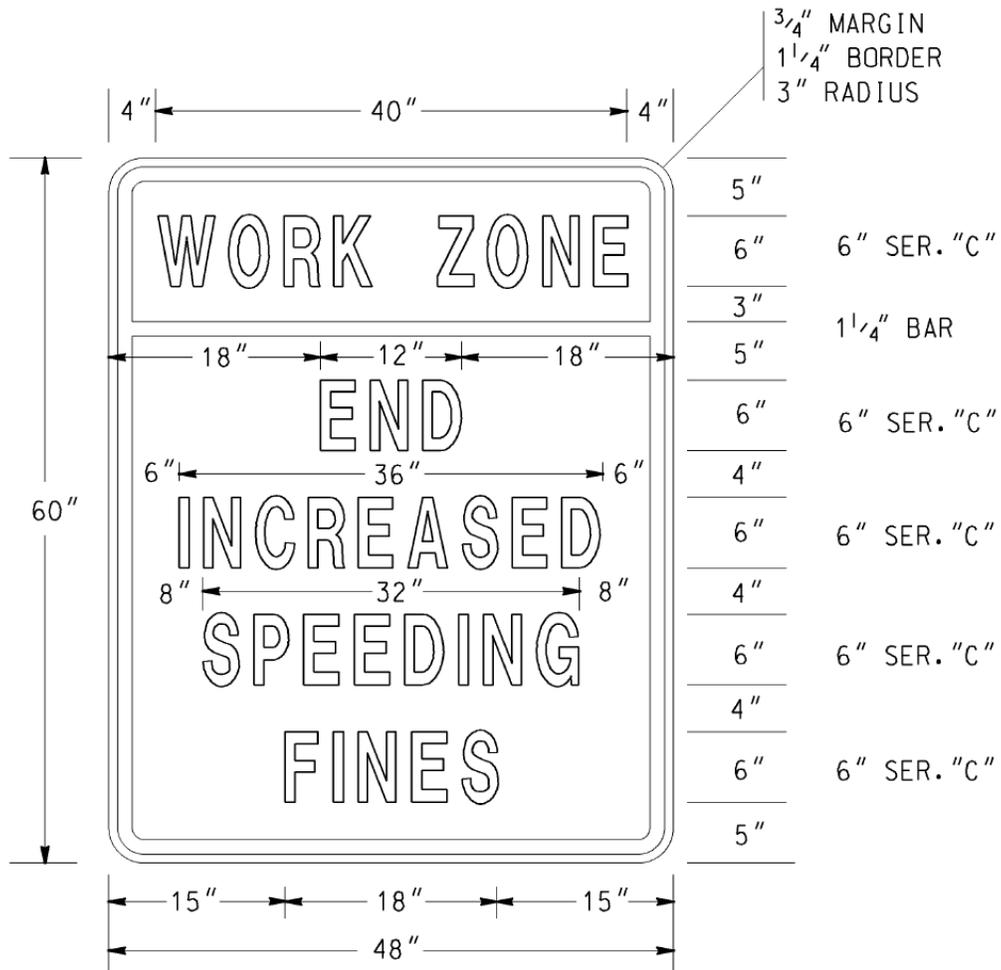
MIDDLE & BOTTOM PANELS

LEGEND & BORDER - BLACK (NON-REFL)

BACKGROUND - WHITE (ASTM TYPE III OR IV REFL SHEETING)

NOTES:

1. ALL HWZ-2 SIGN PANELS SHALL BE RIGID.
2. THE SIZE OF THE HWZ-2 SIGN SHALL NOT BE REDUCED FOR USE ON TWO-LANE ROADWAYS.



HWZ-3

COLORS

TOP PANEL

LEGEND & BORDER - BLACK (NON-REFL)

BACKGROUND - FLUORESENT ORANGE

(ASTM TYPE VII, VIII, IX or X)

BOTTOM PANEL

LEGEND & BORDER - BLACK (NON-REFL)

BACKGROUND - WHITE (ASTM TYPE III OR IV REFL SHEETING)

NOTES:

1. ALL HWZ-3 SIGN PANELS SHALL BE RIGID.
2. THE SIZE OF THE HWZ-3 SIGN SHALL NOT BE REDUCED FOR USE ON TWO-LANE ROADWAYS.

C. LANE CLOSURES:

1. Approval/Restrictions

All lane closures of any type or duration shall have the prior approval of the Engineer.

- a. The length of a lane closure shall not exceed two (2) miles in length excluding the length of the tapers unless the prior approval of the Engineer has been obtained. The Engineer may extend the length of a lane closure based upon field conditions however the length of a workzone should be held to the minimum length required to accomplish the Work. Lane closures shall not be spaced closer than one mile. The advanced warning signs for the project should not overlap with the advanced warning signs for lane shifts, lane closures, etc.
- b. Lane closures that require same direction traffic to be split around the Work Area will not be approved for roadways with posted speeds of 35 mph or greater, excluding turn lanes.
- c. For Interstate, Limited Access and Multi-lane Divided Highways, a Portable Changeable Message Sign (PCMS) shall be placed one (1) mile in advance of a lane closure with a message denoting the appropriate lane closure one mile ahead. The Portable Changeable Message Sign (PCMS) shall be placed on the outside shoulder in accordance with Detail 150-PCMS. This is in addition to the other traffic control devices required by Standard 9106.

2. Removal Of Lane Closures

To provide the greatest possible convenience to the public in accordance with [Sub-Subsection 107.07](#), the Contractor shall remove all signs, lane closure markings, and devices immediately when lane closure work is completed or temporarily suspended for any length of time or as directed by the Engineer. All portable signs and portable sign mounting devices shall be removed from the roadway to an area which will not allow the sign to be visible and will not allow the sign or sign mounting device to be impacted by traffic.

3. Exit And Entrance Ramps

On multilane highways where traffic has been shifted to the inside lanes, the exit and entrance ramps shall have channelization devices placed on both sides of the ramp. This requirement will apply to any situation where traffic is shifted to contra flows or inside staging lanes to facilitate reconstruction work in the vicinity of exit and entrance ramps. The temporary ramp taper length shall be greater than, or equal to, the existing taper length. Interim EXIT gore signs shall be placed at the ramp divergence. The "EXIT OPEN" sign shown in Figure TA-42 of the MUTCD shall be utilized. For exit ramps, channelization device spacing shall be decreased to 10 feet for 200 feet in advance of the temporary gore, and be decreased to 10 feet for the first 100 feet of the temporary gore.

4. Lane Drop/Lane Closure

The first seven (7) calendar days of any lane closure shall be signed and marked as per Standard 9106 or 9107. However, lane closures that exist for a duration longer than seven (7) calendar days may be signed and marked as per the details in Standard 9121, provided the prior approval of the Engineer is obtained. The approved lane drop

shall utilize only the signs and markings shown for the termination end of the lane drop in Standard 9121. All warning signs in the lane drop sequence shall be used. Drums may be substituted for the Type I Crystal Delineators at the same spacing.

5. Termination Area

The transition to normal or full width highway at the end of a lane closure shall be a maximum of 150 feet.

D. TRAFFIC PACING METHOD:

1. Pacing Of Traffic

With prior approval from the Engineer, traffic may be paced allowing the Contractor up to ten (10) minutes maximum to work in or above all lanes of traffic for the following purposes:

- a. Placing bridge members or other bridge work.
- b. Placing overhead sign structures.
- c. Other work items requiring interruption of traffic.

The Contractor shall provide a uniformed police officer with patrol vehicle and blue flashing light for each direction of pacing. The police officer, Engineer, and flaggers at ramps shall be provided with a radio which will provide continuous contact with the Contractor.

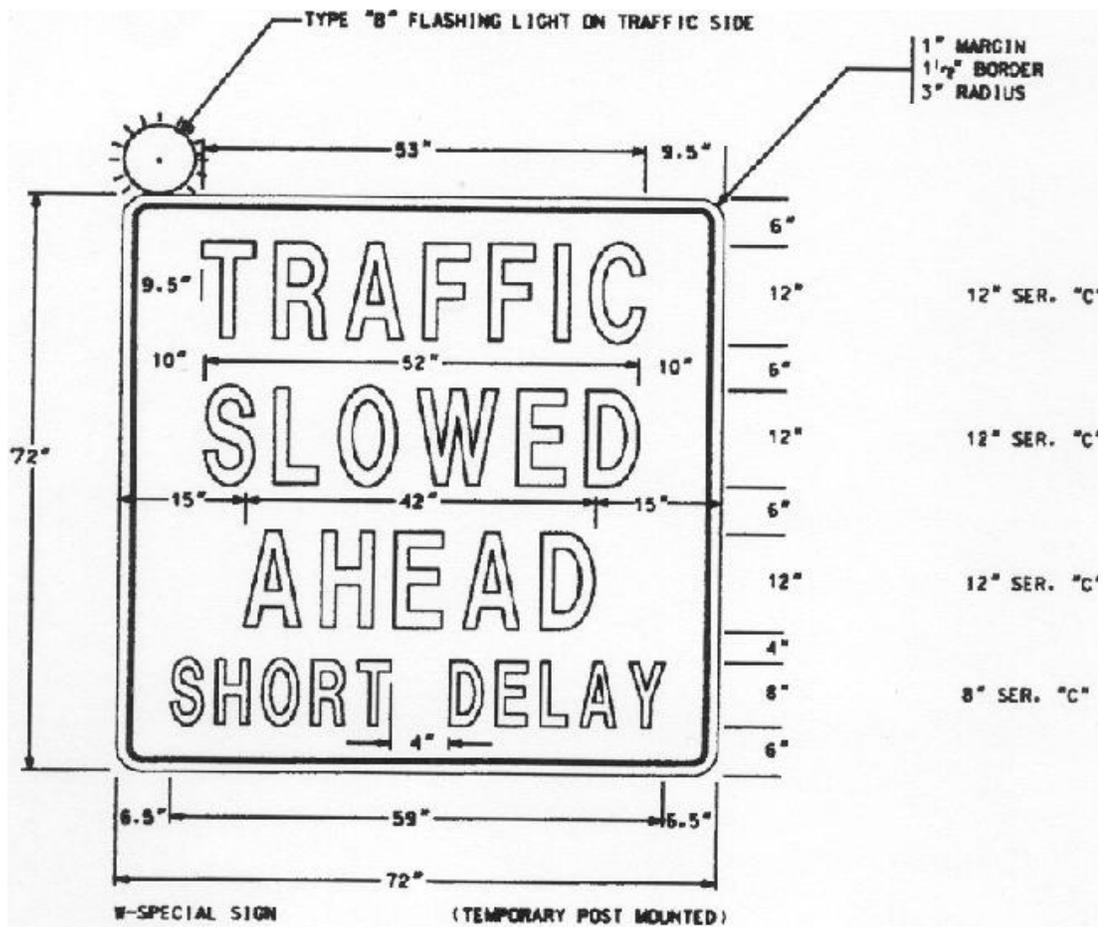
When ready to start the work activity, the police vehicle will act as a pilot vehicle slowing the traffic thereby providing a gap in traffic allowing the Contractor to perform the Work. Any on-ramps between the pace and the work area shall be blocked during pacing of traffic, with a flagger properly dressed and equipped with a Stop/Slow paddle. Each ramp should be opened after the police vehicle has passed.

Pilot vehicles shall travel at a safe pace speed, desirably not less than 20 mph interstate and 10 mph non-interstate. The Contractor shall provide a vehicle to proceed in front of the police vehicle and behind the other traffic in order to inform the Contractor's work force when all vehicles have cleared the area.

Traffic will not be permitted to stop during pacing except in extreme cases as approved by the Engineer.

2. Methods Of Signing For Traffic Pacing

At a point not less than 1,000 feet in advance of the beginning point of the pace, the Contractor shall erect and cover a W-special sign (72 inch x 72 inch) with a Type "B" flashing light, with the legend "TRAFFIC SLOWED AHEAD SHORT DELAY" (See [Detail 150-A](#)). A portable changeable message sign may be used in lieu of the W-special sign. On divided highways this sign shall be double indicated. A worker with a two-way radio shall be posted at the sign, and upon notice that the traffic is to be paced shall turn on the flashing light and reveal the sign. When traffic is not being paced, the flashing light shall be turned off and the sign covered or removed. W-special signs are reflectorized black on orange, Series "C" letter and border of the size specified.



SIGN SHALL HAVE BLACK LEGEND AND BORDER
ON ORANGE REFLECTORIZED BACKGROUND

DETAIL 150-A

E. CONSTRUCTION VEHICLE TRAFFIC

The Contractor's vehicles shall travel in the direction of normal roadway traffic and shall not reverse direction except at intersections, interchanges, or approved temporary crossings. The Contractor may submit a plan requesting that construction traffic be allowed to travel in the opposite direction of normal traffic when it would be desirable to modify traffic patterns to accommodate specific construction activities.

Prior approval of the Engineer shall be obtained before any construction traffic is allowed to travel in a reverse direction. If the Contractor's submittal is approved the construction traffic shall be separated from normal traffic by appropriate traffic control devices.

F. ENVIRONMENTAL IMPACTS TO THE TEMPORARY TRAFFIC CONTROL (TTC) PLAN

The Contractor shall ensure that dust, mud, and other debris from construction activities do not interfere with normal traffic operations or adjacent properties. All outfall ditches, special ditches, critical storm drain structures, erosion control structures, retention basins, etc. shall be constructed, where possible, prior to the beginning of grading operations so that the best possible drainage and erosion control will be in effect during the grading operations, thereby keeping the roadway areas as dry as possible.

Areas within the limits of the project which are determined by the Engineer to be disturbed or damaged due either directly or indirectly from the progress or the lack of progress of the work shall be cleaned up, redressed, and regrassed. All surplus materials shall be removed and disposed of as required. Surplus materials shall be disposed of in accordance with [Section 201](#) of the Specifications.

G. EXISTING STREET LIGHTS

Existing street lighting shall remain lighted as long as practical and until removal is approved by the Engineer.

H. NIGHTWORK

Adequate temporary lighting shall be provided at all nighttime work sites where workers will be immediately adjacent to traffic.

I. CONSTRUCTION VEHICLES IN THE WORKZONE

The parking of Contractor's and/or workers personal vehicles within the work area or adjacent to traffic is prohibited. It shall be the responsibility of the Worksite Traffic Control Supervisor to ensure that any vehicle present at the worksite is necessary for the completion of the work.

J. ENCROACHMENTS ON THE TRAVELED-WAY

The Worksite Traffic Control Supervisor (WTCS) shall monitor the work to ensure that all the rocks, boulders, construction debris, stockpiled materials, equipment, tools and other potential hazards are kept clear of the travelway. These items shall be stored in a location, in so far as practical, where they will not be subject to a vehicle running off the road and striking them.

K. PEDESTRIAN CONSIDERATIONS

All existing pedestrian facilities, including access to transit stops, shall be maintained. Where pedestrian routes are closed, alternate routes shall be provided. Closures of existing, interim and final pedestrian facilities shall have the prior written approval of the Engineer. When existing pedestrian facilities are disrupted, closed or relocated in a TTC zone, the temporary facilities shall be detectable and shall include accessibility features consistent with the features present in the existing pedestrian facility. Pedestrian facilities are considered improvements and provisions made to accommodate or encourage walking. Whenever a sidewalk is to be closed, the Engineer shall notify the maintaining agency two (2) weeks prior to the closure. Prior to closure, detectable barriers (that are detectable by a person with a visual disability traveling with the aid of a long cane), as described by the MUTCD, shall be placed across the full width of the closed sidewalk. Barriers and channelizing devices used along a temporary pedestrian route shall be in compliance with the MUTCD.

Temporary Traffic Control devices used to delineate a Temporary Traffic Control zone pedestrian walkway shall be in compliance with [Subsection 150.01.E](#). Temporary Traffic Control devices and construction material shall not intrude into the usable width of the pedestrian walkway. Signs and other devices shall be placed such that they do not narrow or restrict any pedestrian passage to less than 48 inches.

A pedestrian walkway shall not be severed or relocated for non-construction activities such as parking for construction vehicles and equipment. Movement by construction vehicles and equipment across designated pedestrian walkways should be minimized. When necessary, construction activities shall be controlled by flaggers. Pedestrian walkways shall be kept free of mud, loose gravel or other debris.

When temporary covered walkways are used, they shall be lighted during nighttime hours. When temporary traffic barrier is used to separate pedestrian and vehicular traffic, the temporary barrier shall meet NCHRP-350 Test Level Three. The barrier ends shall be protected in accordance with Georgia Standard 4960. Curbing shall not be used as a substitute for temporary traffic barriers when temporary traffic barriers are required. Tape, rope or plastic chain strung between temporary traffic control devices are not considered as detectable and shall not be used as a control for pedestrian movements.

The WTCS shall inspect the activity area daily to ensure that effective pedestrian TTC is being maintained. The inspection of TTC for pedestrian traffic shall be included as part of the TC-1 report.

1. Temporary Pedestrian Facilities

Temporary pedestrian facilities shall be detectable and include accessibility features consistent with the features present in the existing pedestrian facility. The geometry, alignment and construction of the facility should meet the applicable requirements of the "Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG)".

a. Temporary Walkways with Detectable Edging

A smooth, continuous hard surface (firm, stable and slip resistant) shall be provided throughout the entire length of the temporary pedestrian facility. Compacted soils, sand, crushed stone or asphaltic pavement millings shall not be used as a surface course for walkways.

Temporary walkways shall include detectable edging as defined in the MUTCD. When temporary traffic barrier is included as a pay item in the contract and where locations identified on the plans for positive protection will also allow them to serve as pedestrian detectable edging, payment will be made for the temporary traffic barrier in accordance with [Section 622](#). No payment will be made for temporary walkways with Detectable Edging where existing pavements or existing edging (that meets the requirements of MUTCD) are utilized as temporary walkways. Payment for temporary detectable edging, including approved barriers and channelizing devices, installed on existing pavements shall be included in Traffic Control-Lump Sum.

Regardless of the materials used, temporary walkways shall be constructed of sufficient thickness and durability to withstand the intended use for the duration of the construction project. If concrete or asphalt is used as the surface course for the walkway, it shall be a minimum of one and one-half inches (1-1/2") thick. Temporary walkways constructed across unimproved streets and drives shall be a minimum thickness of four inches (4") for concrete and three inches (3") for asphalt. Joints formed in concrete sidewalks shall be in accordance with [Section 441](#). Concrete surfaces shall have a broom finish.

If plywood is used as a walkway, it must be a minimum of three quarters of an inch (3/4") thick pressure treated and supported with pressure treated longitudinal joists spaced a maximum of sixteen inches (16") on center. The plywood shall be secured to the joist with galvanized nails or galvanized deck screws. Nails and screws shall be countersunk to prevent snagging or tripping the pedestrians. A slip resistant friction course shall be applied to any plywood surface that is used as a walkway. Any slip resistant material used shall have the prior written approval of the engineer.

The contractor may propose alternate types of Temporary Walkways provided the contractor can document that the proposed walkway meets the requirements of the "Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG)". Alternate types of Temporary Walkways shall have the prior written approval of the engineer.

Temporary walkways shall be constructed and maintained so there are no abrupt changes in grade or terrain that could cause a tripping hazard or could be a barrier to wheelchair use. The contractor shall construct and maintain the walkway to ensure that joints in the walkway have a vertical difference in elevation of no more than one quarter (1/4") of an inch and that the horizontal joints have gaps no greater than one half (1/2") of an inch. The grade of the temporary walkway should parallel the grade of the existing walkway or roadway and the cross slope should be no greater than 2%.

A width of sixty (60") inches, if practical, should be provided throughout the entire length of any temporary walkway. The temporary walkway shall be a minimum width of forty eight inches (48"). When it is not possible to maintain a minimum width of sixty inches (60") throughout the entire length of temporary walkway, a sixty inch (60") by sixty inch (60") passing space should be provided at least every two hundred feet (200 Ft.), to allow individuals in wheelchairs to pass.

Temporary walkways shall be constructed on firm subgrade. Compact the subgrade according to [Section 209](#). Furnish and install any needed temporary pipes prior to constructing any walkway to ensure positive drainage away from or beneath the temporary walkway. Once the walkway is no longer required, remove any temporary materials and restore the area to the original conditions or as shown in the plans.

- b. Temporary Curb Cut Wheelchair Ramps
Temporary curb cut wheelchair ramps shall be constructed in accordance with [Section 441](#) and Detail A-3. Ramps shall also include a detectable warning surface in accordance with Detail A-4. Other types of material for the construction of the temporary curb cut wheelchair ramps, including the detectable warning surface, may be used provided the contractor can provide documentation that the material to be used meets the requirements of the "Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG)". When a wheelchair ramp is no longer required, remove the temporary materials and restore the area to existing conditions or as shown in the plans. For the items required to restore the area to original conditions or as shown in the plans, measures for payment shall be covered by contract pay items. If pay items are not included in the contract, then payment for these items shall be included in Traffic Control-Lump Sum.
- c. Temporary Audible Information Device
Temporary audible information devices, when shown in the plans, shall be installed in compliance with the "Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG)". The devices shall be installed in accordance with the manufacturer's recommendations. Prior to installation, the contractor shall provide the engineer with a set of manufacturer's drawings detailing the proper installation procedures for each device. When no longer required, the devices shall remain the property of the contractor.

L. TRAFFIC SIGNALS

If the sequence of operations, staging, or the temporary traffic control plan requires the relocation or shifting of any components of an existing traffic signal system then any work on these traffic signals will be considered as part of Lump Sum- Traffic Control. The contractor becomes responsible for the maintenance of these traffic signals from the time that the system is modified until final acceptance. The maintenance of traffic signals that are not a part of the work and are not in conflict with any portion of the work shall not be the responsibility of the contractor.

When construction operations necessitate an existing traffic signal to be out of service, the Contractor shall furnish off-duty police officers to regulate and maintain traffic control at the site. Off-duty police officers should be used to regulate and maintain traffic control at signal sites when lane closures or traffic shifts block or restrict movements causing interference with normal road user flows and will not allow the activated traffic signal to guide the traffic through the signal site.

M. REMOVAL/REINSTALLATION OF MISCELLANEOUS ITEMS

In the prosecution of the Work, if it becomes necessary to remove any existing signs, markers, guardrail, etc. not covered by specific pay item, they shall be removed, stored and reinstalled, when directed by the Engineer, to line and grade, and in the same condition as when removed.

N. Signalized Intersections

Off duty police officers shall be used to regulate and maintain traffic control at functioning signalized intersections when lane closures or traffic shifts block or restrict movements causing interference with road user flows and will not allow the activated traffic signal to guide the traffic through the signal site. This work is considered incidental and shall be included in the overall price bid for traffic control.

150.03 SIGNS:

A. SIGNING REQUIREMENTS OF THE TEMPORARY TRAFFIC CONTROL (TTC) PLAN

When existing regulatory, warning or guide signs are required for proper traffic and pedestrian control the Contractor shall maintain these signs in accordance with the temporary traffic control (TTC) plan. The Contractor shall review the status of all existing signs, interim signs added to the work, and permanent sign installations that are part of the work to eliminate any conflicting or non-applicable signage in the TTC Plan. The Contractor's review of all signs in the TTC Plan shall establish compliance with the requirements of the MUTCD and Section 150. Any conflicts shall be

reported to the Engineer immediately and the WTCS shall take the necessary measures to eliminate the conflict.

The Contractor shall make every effort to eliminate the use of interim signs as soon as the Work allows for the installation of permanent signs.

All existing illuminated signs shall remain lighted and be maintained by the Contractor.

Existing street name signs shall be maintained at street intersections.

B. CONFLICTING OR NON-APPLICABLE SIGNS

Any sign(s) or portions of a sign(s) that are not applicable to the TTC plan shall be covered so as not to be visible to traffic or shall be removed from the roadway when not in use. The WTCS shall review all traffic shifts and changes in the traffic patterns to ensure that all conflicting signs have been removed. The review shall confirm that the highest priority signs have been installed and that signs of lesser significance are not interfering with the visibility of the high priority signs. High priority signs include signs for road closures, shifts, detours, lane closures and curves. Any signs, such as speed zones and speed limits, passing zones, littering fines and litter pick up, that reference activities that are not applicable due to the presence of the Work shall be removed, stored and reinstalled when the Work is completed.

Failure to promptly eliminate conflicting or non-applicable signs shall be considered as non-performance under [Section 150.08](#).

C. REMOVAL OF EXISTING SIGNS AND SUPPORTS

The Contractor shall not remove any existing signs and supports without prior approval from the Engineer. All existing signs and supports which are to be removed shall be stored and protected if this material will be required later in the work as part of the TTC plan. If the signs are not to be utilized in the work then the signs will become the property of the Contractor unless otherwise specified in the contract documents.

D. INTERIM GUIDE, WARNING AND REGULATORY SIGNS

Interim guide, warning, or regulatory signs required to direct traffic and pedestrians shall be furnished, installed, reused, and maintained by the Contractor in accordance with the MUTCD, the Plans, Special Provisions, Special Conditions, or as directed by the Engineer. These signs shall remain the property of the Contractor. The bottom of all interim signs shall be mounted at least seven (7') feet above the level of the pavement edge when the signs are used for long-term stationary operations as defined by Section 6G.02 of the MUTCD. Special Conditions under Subsection 150.11 may modify this requirement.

Portable signs may be used when the duration of the work is less than three (3) days or as allowed by the special conditions in Subsection 150.11. Portable signs shall be used for all punchlist work. All portable signs and sign mounting devices utilized in work shall be NCHRP 350 compliant. Portable interim signs shall be mounted a minimum of one (1') foot above the level of the pavement edge for directional traffic of two (2) lanes or less and a minimum of seven (7') feet for directional traffic of three (3) or more lanes. Signs shall be mounted at the height recommended by the manufacturer's crashworthy testing requirements. Portable interim signs which are mounted at less than seven (7') feet in height may have two 18 inch x 18 inch fluorescent red-orange or orange-red warning flags mounted on each sign.

All regulatory sign blanks shall be rigid whether the sign is mounted as a portable sign, on a Type III barricade or as a permanent mount height sign.

Any permanent mount height interim sign that is designed to fold in half to cover a non-applicable message on the sign shall have reflectorized material on the folded over portion of the sign. The reflectorized material shall be orange in color with a minimum of ASTM Type I engineering grade sheeting with a minimum area of six inches by six inches (6" x 6") facing the direction of traffic at all times when the sign is folded.

Interim signs may be either English or metric dimensions.

E. EXISTING SPECIAL GUIDE SIGNS

Existing special guide signs on the Project shall be maintained until conditions require a change in location or legend content. When change is required, existing signs shall be modified and continued in use if the required modification can be made within existing sign borders using design requirements (legend, letter size, spacing, border, etc.) equal to that of the existing signs, or of [Subsection 150.03.E.2.](#) Differing legend designs shall not be mixed in the same sign.

1. Special Guide Signs

Special guide signs are those expressway or freeway guide signs that are designed with a message content (legend) that applies to a particular roadway location. When an existing special guide sign is in conflict with work to be performed, the Contractor shall remove the conflicting sign and reset it in a new, non-conflicting location which has been approved by the Engineer.

2. Interim Special Guide Signs

When it is not possible to utilize existing signs, either in place or relocated, the Contractor shall furnish, erect, maintain, modify, relocate, and remove new interim special guide signs in accordance with the Plans or as directed by the Engineer. Interim special guide signs that may be required in addition to, or a replacement for, existing expressway and freeway (interstate) signs shall be designed and fabricated in compliance with the minimum requirements for guide signing contained in Part 2E "Guide Signs Expressway" and Part 2F "Guide Signs Freeways" of the MUTCD, except that the minimum size of all letters and numerals in the names and places, streets and highways on all signs shall be 16 inches Series "E" initial upper-case and 12 inches lower-case. All interstate

shields on these signs shall be 48 inches and 60 inches for two-numeral and three-numeral routes, respectively.

The road name of the exit or route shield shall be placed on the exit gore sign.

3. Interim Overhead Guide Sign Structures

Interim overhead special guide sign structures are not required to be lighted unless specifically required by the Plans. If lighting is required the sign shall be lighted as soon as erected and shall remain lighted, during the hours of darkness, until the interim sign is no longer required. The Contractor shall notify the Power Company at least thirty (30) days prior to desired connection to the power source.

4. Permanent Special Guide Signs

The installation of new permanent special guide signs and the permanent modification or resetting of existing special guide signs, when included in the contract, shall be accomplished as soon as practical to minimize the use of interim special guide signs. If lighting is required by the Plans, all new permanent overhead special guide signs shall be lighted as soon as erected.

F. MATERIALS- INTERIM SIGNS:

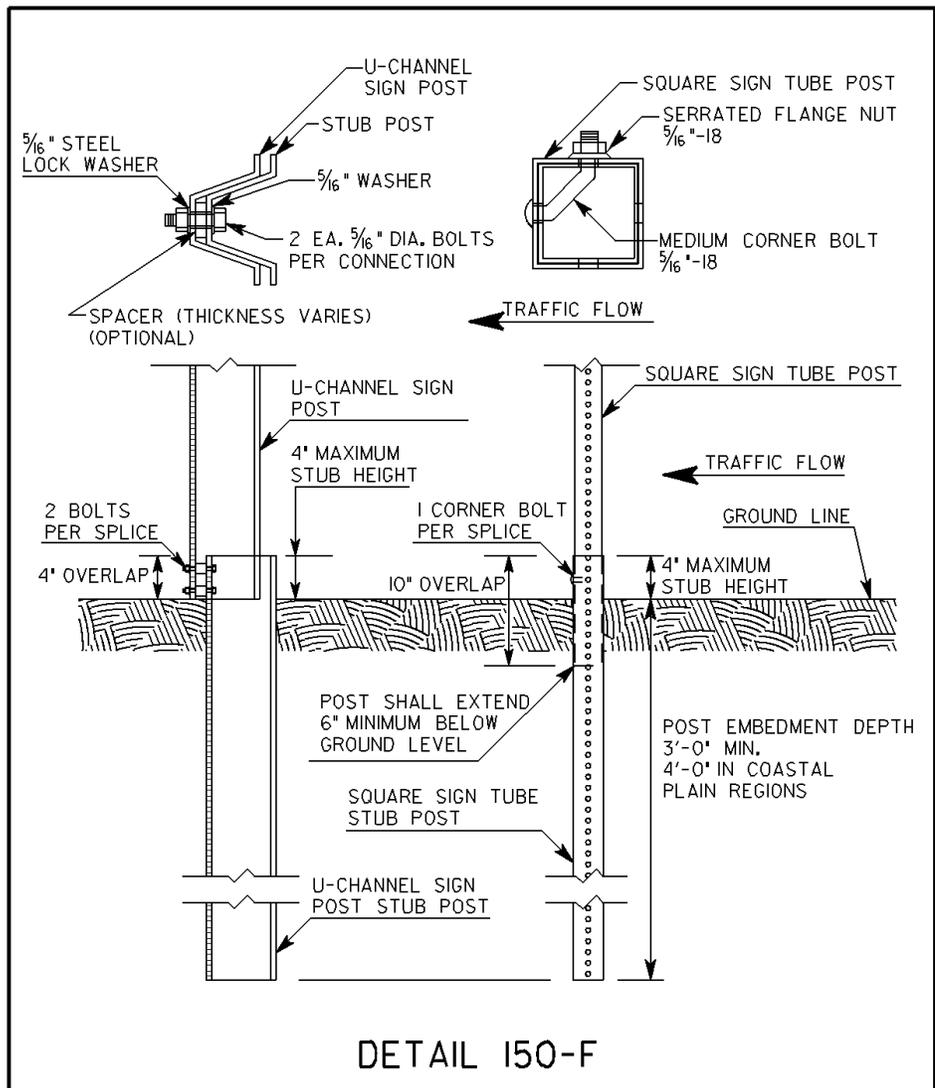
1. Posts

Permanent mounting height of seven (7') feet- Posts for all interim signs shall meet the requirements of Section 911 except that green or silver paint may be used in lieu of galvanization for steel posts or structural shape posts. Within the limits of a single project, all metal posts shall be the same color. Wood posts are not required to be pressure treated. Ground mounted sign(s) greater than nine (9) square feet shall be mounted on two posts.

Interim posts may be either metric or English in dimensions.

Posts for all interim signs shall be constructed to yield upon impact unless the posts are protected by guardrail, portable barrier, impact attenuator or other type of positive barrier protection. Unprotected posts shall meet the breakaway requirements of the "1994 AASHTO Standard Specifications for Structural Support for Highway Signs, Luminaries and Traffic Signals". Unprotected interim posts shall be spliced as shown in [Detail 150-F](#) unless full length unspliced posts are used.

Unprotected post splices will not be permitted any higher than four inches above the ground line to lessen the possibility of affecting the undercarriage of a vehicle. Installation of posts may require establishment of openings in existing pavements, islands, shoulders etc.



- 2. Sign Blanks And Panels- Permanent mounting height of seven (7') feet-**
All sign blanks and panels shall conform to [Section 912](#) of the Specifications except that blanks and panels may be ferrous based or other metal alloys. Type 1 and Type 2 sign blanks shall have a minimum thickness of 0.08 inches regardless of the sign type used. Alternative sign blank materials (composites, poly carbonates, fiberglass reinforced plastics, recycled plastics, etc.) shall have a letter of approval from the Office of Materials and Research for use as interim construction signs before these materials are allowed to be incorporated into the work unless these rigid sign blanks are currently approved as a crashworthy sign blank material under QPL 34. The back side of sign panels shall be painted orange to prevent rust if other metals are used in lieu of aluminum. Plywood blanks or panels will not be permitted. The use of flexible signs will not be permitted for permanent mount height signs.

Interim blanks and panels may be either metric or English in dimensions.

- 3. Portable Sign Mounting Devices, Portable Sign Blanks-**
All portable sign mounting devices and sign blanks utilized in the work shall be NCHRP 350 Test Level III compliant. All portable sign mounting devices and sign blanks shall be from the Qualified Products List. Any sign or sign mounting device shall have an identifying decal, logo, or manufacturer's stamping that clearly identifies the device as NCHRP 350 compliant. The required decal, logo or manufacturer's stamping shall not be displayed on the message face of the sign. The Contractor may be required to provide certification from the Manufacturer as proof of NCHRP 350 compliance. All portable signs shall be mounted according to height requirements of [Subsection 150.03.D](#).

G. SIGN VISIBILITY AND OFFSETS

All existing, interim and new permanent signs shall be installed so as to be completely visible for an advance distance in compliance with the MUTCD. Any clearing required for maintaining the line of sight to existing, interim or permanent signs shall be done as part of the requirements of the TTC plan. The clearing shall include any advance warning signs, both interim and permanent, that are installed as a part of the work including advance warning signs that are installed outside the limits of the project. Any sign installed behind W-beam or T-beam guardrail with non-breakaway posts shall be installed with the leading edge of the sign a minimum of four feet and three inches (4'3") behind the face of the guardrail with five feet (5') of clearance being desirable. Limbs, brush, construction equipment and materials shall be kept clear of the driver's line of sight to all signs that are part of the TTC plan.

H. ADVANCE WARNING SIGNS:

1. All Type Of Highways

Advance warning signs shall be placed ahead of the work area in accordance with Part VI of the MUTCD and shall include a series of at least three advance road work (W20-1) signs placed at the termini of the project. The series shall have the legend ROAD WORK (1500 FEET, 1000 FEET, AND 500 FEET).

At grade intersecting roadways and on-ramps shall be signed with a minimum of one ROAD WORK AHEAD sign.

When work terminates at a "T" intersection, a minimum of one "ROAD WORK AHEAD" sign shall be placed in advance of the intersection and one "END ROAD WORK" sign shall be placed at the termination end of the intersection. Field conditions may require the use of additional warning signage.

Advanced Warning Signs on State Routes shall be a minimum dimension of 48 inches x 48 inches. When a State Route intersects a project which consists of adding travel lanes, reconstructing an existing roadway or new location work, the State Route approaches shall have a minimum of three (W20-1) advanced warning signs (1500 ft., 1000 ft., 500 ft.). The termination end of an intersecting State Route shall have END ROAD WORK signage.

The W20-1 signs shall be placed at the termini of the project or sufficiently in advance of the termini to allow for lane shifts, lane closures and other activities which may also require advanced warning signs. The advanced warning signs for the project should not overlap with the advanced warning signs for lane shifts, lane closures, etc.

The length of a workzone should be held to the minimum length required to accomplish the work. If a project has multiple individual worksites within the overall limits of the project, each site should be signed individually if the advance warning signs for each site can be installed without overlapping an adjacent worksite. As soon as the work is completed at any individual site the warning signs shall be removed from that site. Clean-up work and punchlist work shall be performed with portable signage.

Project mileage indicated on the G20-1 sign shall be the actual project mileage rounded up to the nearest whole mile. Projects less than two (2) miles in length or individual worksites that are part of a multiple worksite project may delete this sign. The G20-1 sign shall be 60" X 36" and the G20-2 sign shall be 48" X 24".

2. Interstate, Limited Access And Multilane Divided Highways

In addition to the W20-1 signs required at 500 ft., 1000 ft. and 1500 ft., multi-lane divided highways shall also have additional advanced warning signs installed with the legend "ROAD WORK (2 MILES, 1 MILE and 1/2 MILE). All construction warning signs on divided highways shall be double indicated (i.e., on the left and right sides of the roadway.) If the use of the 1/2 mile, 1 mile and 2 mile advanced warning signs cause an overlap with other work or do not benefit field conditions then the Engineer may review the use of these signs and eliminate their installation. When the posted speed limit is 50 MPH or less, the 1/2 mile, 1 mile and 2 mile signs should be eliminated especially in urban areas.

The W20-1 advance warning signs for ROAD WORK 500 FEET; 1000 FEET; and 1500 FEET shall be temporarily covered when work involving the advanced warning signs for lane shifts and lane closures overlap these signs. The ROAD WORK 1/2 MILE, ROAD WORK 1 MILE, and ROAD WORK 2 MILES shall be in place when the 500, 1000 and 1500 feet signs are temporarily covered.

When the temporary traffic control zone already has advanced warning (W20-1) signs installed the W20-1 signs required for lane closures under Standard 9106 should be eliminated.

RAMP WORK ON LIMITED ACCESS HIGHWAYS: The workzone shall not be signed for the entire length of the mainline of a limited access highway when only short individual worksites, interchange or ramp work is being performed.

When work is restricted to ramp reconstruction or widening activities, the advance warning signs on the mainline section of the limited access highway shall be limited to the use of portable advance warning signs. These portable advance warning signs shall only be utilized when work activity is within the gore point of the ramp and the mainline traveled way or work is active in the accel/decel lane adjacent to the mainline traveled way. Portable advance warning signs (W20-1; 1500ft. /1000 ft. /500ft.) shall be installed on the traveled way of the limited access highway when the above conditions are present. The advance warning signs shall be installed only in one direction where work is active. All portable signs shall be double indicated. When work is not active, the ramp work shall be advanced warned by the use of a single 48 inch X 48 inch "RAMP WORK AHEAD" sign along the right shoulder of the mainline traveled way prior to the beginning of the taper for the decel lane. The "RAMP WORK AHEAD" sign shall be mounted at seven (7') feet in height. Differences in elevation shall be in compliance with the requirements of [Subsection 150.06](#) prior to the removal of the portable (W20-1) advanced warning signs from the mainline.

The G20-1 sign shall be eliminated on limited access highways when the work involves only ramp work, bridge reconstruction, bridge painting, bridge joint repairs, guardrail and anchor replacement or other site specific work which is confined to a short section of limited access highway.

I. PORTABLE CHANGEABLE MESSAGE SIGN

Unless specified as a paid item in the contract the use of a portable changeable message sign will not be required. When specified, a portable changeable message sign (PCMS) shall meet the minimum requirements of [Section 632](#) and the MUTCD. The maximum amount of messages allowed to be flashed on one PCMS is two phases (flashes). The language and the timing of the messages shall comply with the MUTCD and Section 632.

When used as an advanced device the PCMS should typically be placed ahead of the construction activities. If the PCMS is used as a substitute for another device then the requirements for the other device apply.

J. FLASHING BEACON

The flashing beacon assembly, when specified, shall be used in conjunction with construction warning signs, regulatory, or guide signs to inform traffic of special road conditions which require additional driver attention. The flashing beacon assembly shall be installed in accordance with the requirements of [Section 647](#).

K. RUMBLE STRIP SIGNAGE

Signage for rumble strips located in the travelway shall be as required in [Subsection 150.01.C](#) and [Subsection 150.02.A.9](#).

L. LOW/SOFT SHOULDER SIGNAGE

Low or soft shoulder signs shall be utilized in accordance with the following conditions:

CONSTRUCTION/RECONSTRUCTION PROJECTS:

"LOW/SOFT SHOULDER" signs shall be erected when a difference in elevation exceeds one (1") inch but does not exceed three (3") inches between the travelway and any type of shoulder unless the difference in elevation is four (4') feet or greater from the edge of the traveled way.

The spacing of the signs shall not exceed one (1) mile and the signs shall be placed immediately past each crossroad intersection. The "Low/Soft" signs shall remain in place until the difference in elevation is eliminated and the shoulder has been dressed and permanently grassed for a minimum of thirty (30) calendar days. These signs shall be furnished, installed, maintained and removed by the Contractor as part of Traffic Control-Lump Sum. These signs shall be orange with black borders and meet the reflectorization requirements of [Subsection 150.01.D](#).

"SHOULDER DROP-OFF" (W8-9a) signs shall be used when a difference in elevation, less than four (4') feet from the traveled way, exceeds three (3") inches and is not protected by positive barrier protection. These warning signs shall be placed in advance of the drop-off.

For a continuous drop-off condition, the W8-9a) signs shall, as a minimum, be spaced in accordance with the above requirements for "Low/soft shoulder" signs.

PROJECTS CONSISTING PRIMARILY OF ASPHALTIC CONCRETE RESURFACING ITEMS:

"LOW/SOFT SHOULDER" signs shall be erected when a difference in elevation exceeds one (1") inch but does not exceed three (3") inches between the travelway and any type of shoulder unless the difference in elevation is four (4') feet or greater from the edge of the traveled way.

SHOULDER BUILDING INCLUDED IN THE CONTRACT: "Low/Soft Shoulder" signs shall be erected as per the requirement of Standards 9102, 9106, and 9107. "Shoulder Drop-off" signs (W8-9a) shall be erected as per the requirements of the MUTCD. These signs shall be maintained until the conditions requiring their installation have been eliminated. The Contractor shall remove all interim warning signs before final acceptance.

SHOULDER BUILDING NOT INCLUDED IN THE CONTRACT: The Department will furnish the "Low/Soft Shoulder" signs, "Shoulder Drop-off" signs and the posts. The signs shall be erected to meet the minimum requirements of [Subsection 150.03](#). The Contractor shall include the cost of furnishing installation hardware (bolts, nuts, and

washers), erection and maintenance of the signs in the bid price for Traffic Control-Lump Sum. The Contractor shall maintain the signs until final acceptance. The Department will remove the signs.

LAU/LAR PROJECTS SHOULDER BUILDING NOT INCLUDED IN THE CONTRACT: The Contractor will furnish, install and maintain LOW/SOFT SHOULDER signs (yellow with black borders, ASTM Type III or IV) at the appropriate spacing, until Final Acceptance of the project by the Department. After Final Acceptance by the Department the signs will become the property and responsibility of the local government.

M. BUMP SIGNAGE:

MULTI-LANE DIVIDED HIGHWAYS: A bump sign (W8-1) shall be utilized when a transverse joint in the pavement structure has a vertical difference in elevation of three quarters (3/4") of an inch or greater in depth with no horizontal taper to ramp the traffic from one elevation to the other. This condition typically occurs at approach slabs during pavement milling operations and at transverse joints in asphaltic pavement lifts.

TWO-LANE TWO-WAY HIGHWAYS: A bump sign (W8-1) shall be utilized when a transverse joint in the pavement structure has a vertical difference in elevation that exceeds one and three quarters (1-3/4") inches in depth with no horizontal taper to ramp the traffic from one elevation to the other. This includes utility and storm drainage repairs that require concrete placement for patching and/or steel plating.

The (W8-1) sign shall be placed sufficiently in advance to warn the motorist of the condition.

N. PEDESTRIAN SIGNAGE:

Appropriate signs as described in the MUTCD shall be maintained to allow safe passage of pedestrian traffic or to advise pedestrians of walkway closures (Refer to MUTCD Figures TA-28 and TA-29 for guidance). Advance closure signing should be placed at intersections rather than midblock locations so that pedestrians are not confronted with midblock work sites that will induce them to attempt skirting the work site or making a midblock crossing. Signs and other devices mounted lower than seven (7) feet above the temporary pedestrian walkway shall not project more than four (4) inches into the accessible pedestrian facilities. Signs and other devices shall be placed such that they do not narrow any pedestrian passage to less than 48 inches.

150.04 PAVEMENT MARKINGS

A. GENERAL

Full pattern pavement markings in accordance with [Section 652](#) and in conformance with Section 3A and 3B, except 3B.02, of the MUTCD are required on all courses before the roadway is opened to traffic. No passing zones shall be marked to conform to [Subsection 150.04.E](#). During construction and maintenance activities on all highways open to traffic, both existing markings and markings applied under this Section shall be fully maintained until Final Acceptance. If the pavement markings are, or become, unsatisfactory in the judgement of the Engineer due to wear, weathering, or construction activities, they shall be restored immediately.

1. Resurfacing Projects

Pavement markings shall be provided on all surfaces that are placed over existing markings. Interim and final markings shall conform in type and location to the markings that existed prior to resurfacing unless changes or additions are noted in the Contract. The replacement of parking spaces will not be required unless a specific item or note has been included in the Contract. Any work to make additions to the markings that existed prior to resurfacing is to be considered as extra work.

2. Widening And Reconstruction Projects

If the lane configuration is altered from the preconstruction layout then pavement markings will be as required by the plans or the Engineer.

3. New Location Construction Projects

Pavement marking plans will be provided.

B. MATERIALS

All traffic striping applied under this Section shall be a minimum four inches in width or as shown in plans and shall conform to the requirements of [Section 652](#), except as modified herein. Raised pavement markers (RPMs) shall meet the requirements of [Section 654](#). Markings on the final surface course, which must be removed, shall be a removable type. The Contractor will be permitted to use paint, thermoplastic, or tape on pavement which is to be overlaid as part of the project, unless otherwise directed by the Engineer. Partial (skip) reflectorization (i.e. reflectorizing only a portion of a stripe) will not be allowed.

C. INSTALLATION AND REMOVAL OF PAVEMENT MARKINGS:

INSTALLATION: All pavement markings, both interim and permanent, shall be applied to a clean surface. The Contractor shall furnish the layout and preline the roadway surface for the placement of pavement markings applied as part of the temporary traffic control plan. All interim marking tape and RPM's on the final surface shall be removed prior to the placement of the final markings.

The Contractor shall sequence the work in such a manner as to allow the installation of markings in the final lane configuration at the earliest possible stage of the work.

REMOVAL: Markings no longer applicable shall be removed in accordance with [Subsection 656.3.05](#).

THE ELIMINATION OF CONFLICTING PAVEMENT MARKINGS BY OVERPAINTING WITH UNAPPROVED PAINT OR ANY TYPE OF LIQUID ASPHALT IS NOT ACCEPTABLE.

INTERMEDIATE SURFACE: Interim markings shall be removed by methods that will cause minimal damage to the pavement surface while also ensuring that traveling public will not be confused or misdirected by any residual markings remaining on the intermediate surface. The use of approved black-out tape and black-out paint (manufactured for the sole purpose of covering existing pavement markings) may be permitted on some interim surfaces, provided the results are satisfactory to the Engineer.

FINAL SURFACE: No interim paint or thermoplastic markings will be permitted on any final surface unless the interim markings are in alignment with the location of the permanent markings and the interim marking will not interfere or adversely affect placement of the permanent markings. The proposed method of removal for layout errors that require markings to be removed from the final surface shall have the prior approval of the Engineer. Any damage to the final pavement surface caused by the pavement marking removal process shall be repaired at the Contractor's expense by methods acceptable and approved by the Engineer. [Subsection 400.3.06.C](#) shall apply when corrective measures are required. The use of black-out tape or black-out paint will not be permitted under any circumstance to correct layout errors on any final surface.

Traffic shifts that are done on the final surface shall be accomplished using interim traffic marking tape that can be removed without any blemishing of the final surface. Interim traffic marking tape shall be used on any of the following final surfaces; asphaltic concrete, Portland cement concrete, and bridge deck surfaces. The contractor may propose alternate traffic markings and removal methods on the final surface. Submitted proposals shall include the type of material, method of removal and a cost comparison to the traffic marking tape method. Prior to any approval, the contractor shall field demonstrate to the satisfaction of the Engineer that the proposed traffic markings can be removed without any blemishing of the final surface. If the proposal is determined to be acceptable, a supplemental agreement will be executed prior to the installation of the proposed alternate traffic markings. The supplemental agreement shall denote the type of traffic marking materials, method of removal and any cost and/or time savings to the Department. The Department will not consider or participate in any cost increase that may result from implementing the proposed alternate method.

PAY FACTOR REDUCTION FOR ASPHALTIC CONCRETE FINAL SURFACES: When the correction of an error in the layout of the final pavement markings requires the final surface to be grounded, blemished, scarred, or polished the pay factor shall be reduced to 0.95 for the entire surface area of the final topping that has a blemish, polished or a scarred surface. The reduced pay factor shall not be confined to only the width and length of the stripe or the dimensions of the blemished areas, the whole roadway surface shall have the reduced pay factor applied. The area of the

reduced pay factor shall be determined by the total length and the total width of the roadway affected. If the affected area is not corrected, the reduction in pay shall be deducted from the final payment for the topping layer of asphaltic concrete. The Engineer shall make the final determination whether correction or a reduced pay factor is acceptable.

The eradication of pavement markings on intermediate and final concrete surfaces shall be accomplished by a method that does not grind, polish, or blemish the surface of the concrete. The method used for the removal of the interim markings shall not spall chip the joints in the concrete and shall not damage the sealant in the joints. Any joint or sealant repairs shall be included in the bid price for Traffic Control-Lump Sum. The proposed method of removal shall have the prior approval of the Engineer.

Failure to promptly remove conflicting or non-applicable pavement markings shall be considered as non-performance under [Subsection 150.08](#).

PREPARATION AND PLANNING FOR TRAFFIC SHIFTS: When shifting of traffic necessitates removal of centerline, lane lines, or edge lines, all such lines shall be removed prior to, during, or immediately after any change so as to present the least interference with traffic. Interim traffic marking tape shall be used as a temporary substitute for the traffic markings being removed.

Before any change in traffic lane(s) alignment, marking removal equipment shall be present on the project for immediate use. If marking removal equipment failures occur, the equipment shall be repaired or replaced (including leasing equipment if necessary), so that the removal can be accomplished without delay.

Except for the final surface, markings on asphaltic concrete may be obliterated by an overlay course, when approved by the Engineer. When an asphaltic concrete overlay is placed for the sole purpose of eliminating conflicting markings and the in place asphaltic concrete section will allow, said overlay will be eligible for payment only if designated in the Plans. Overlays to obliterate lines will be paid for only once and further traffic shifts in the same area shall be accomplished with removable markings. Only the minimum asphaltic concrete thickness required to cover lines will be allowed. Excessive build-up will not be permitted. When an overlay for the sole purpose of eliminating conflicting markings is not allowed, the markings no longer applicable shall be removed in accordance with [Subsection 656.3.05](#).

D. RAISED PAVEMENT MARKERS

Raised pavement markers (RPMs) are required as listed below for all asphaltic concrete pavements before the roadway is open to traffic. On the final surface, RPM's shall be placed according to the timeframes specified in 150.04 E. for full pattern pavement markings except Interstate Highways where RPM's shall be placed and/or maintained when the roadway is open to traffic. When Portland Cement Concrete is an intermediate or final surface and is open to traffic, one calendar day is allowed for cleaning and drying before the installation of RPMs is required.

Raised pavement markers are not allowed on the right edge lines under any situation.

1. Interstate Highways

Retro-reflective raised pavement markers (RPM's) shall be placed and/or maintained on intermediate pavement surfaces on all interstate highways that are open to traffic. This includes all resurfacing projects along with widening and reconstruction projects. The spacing and placement shall be as required for MULTI-LANE DIVIDED HIGHWAYS.

2. Multi-Lane Divided Highways

Retro-reflective raised pavement markers (RPMs) shall be placed and/or maintained on intermediate pavement surfaces on all multi-lane divided highways that are opened to traffic when these roadways are being widened or reconstructed. Two lane-two way roadways that are being widened to a multi-lane facility, whether divided or undivided, are included in this provision. Projects consisting primarily of asphalt resurfacing items or shoulder widening items are excluded from this requirement. The RPMs shall be placed as follows:

a. SUPPLEMENTING LANE LINES

80 foot center on skip lines with curvature less than three degrees. (Includes tangents)

40 foot centers on solid lines and all lines with curvature between three degrees and six degrees.

20 foot centers on curves over six degrees.

20 foot centers on lane transitions or shifts.

b. SUPPLEMENTING RAMP GORE LINES

20 foot centers, two each, placed side by side.

c. OTHER LINES

As shown on the plans or directed by the Engineer.

3. Other Highways

On other highways under construction RPMs shall be used and/or maintained on intermediate pavement surfaces as follows:

a. SUPPLEMENTING LANE LINES AND SOLID LINES

40 foot centers except on lane shifts. (When required in the Plans or Contract.)

20 foot centers on lane shifts. (Required in all cases.)

b. SUPPLEMENTING DOUBLE SOLID LINES

40 foot centers (one each beside each line) except on lane shifts. (When required in the Plans or Contract.)

20 foot centers on lane shifts. (Required in all cases.)

E. EXCEPTIONS FOR INTERIM MARKINGS

Some exceptions to the time of placement and pattern of markings are permitted as noted below; however, full pattern pavement markings are required for the completed project.

1. Two-Lane, Two-Way Roadways

a. SKIP LINES

All interim skip (broken) stripe shall conform to [Section 652](#) except that stripes shall be at least two feet long with a maximum gap of 38 feet. On curves greater than six degrees, a one-foot stripe with a maximum gap of 19 feet shall be used. In lane shift areas solid lines will be required. Interim skip lines shall be replaced with markings in full compliance with [Section 652](#) prior to expiration of the 14 calendar day period.

Interim raised pavement markers may be substituted for the interim skip (broken) stripes. If raised pavement markers are substituted for the two foot interim skip stripe, three markers spaced at equal intervals over a two feet distance will be required. No separate payment will be made if the interim raised pavement markers are substituted for interim skip lines.

Interim raised pavement markers shall be retro-reflective, shall be the same color as the pavement markers for which they are substituted, and shall be visible during daytime.

The type of interim marker and method of attachment to the pavement shall be approved by the Office of Materials and Research but in no case will the markers be attached by the use of nails. Flexible reflective markers, Type 14 or Type 15, may be used for a maximum of fourteen (14) calendar days as an interim marker. Any flexible reflective markers in use shall be from the qualified products list (QPL).

The interim raised pavement markers shall be maintained until the full pattern pavement markings are applied. At the time full pattern markings are applied the interim raised markers shall be removed in a manner that will not interfere with application of the full pattern pavement markings.

b. NO PASSING ZONES-TWO-LANE, TWO-WAY ROADWAYS

Passing zones shall be re-established in the locations existing prior to resurfacing. No changes to the location of passing zones shall be done without the written approval of the Engineer. For periods not to exceed three calendar days where interim skip centerlines are in place, no-passing

zones shall be identified by using post or portable mounted DO NOT PASS regulatory signs (R4-1 24" x 30") at the beginning and at intervals not to exceed ½ mile within each no-passing zone. A post or portable mounted PASS WITH CARE regulatory sign (R4-1 24" x 30") shall be placed at the end of each no-passing zone. Post mounted signs shall be placed in accordance with the MUTCD. Portable signs shall conform to the requirements of the MUTCD and shall be NCHRP 350 compliant. Portable signs shall be secured in such a manner to prevent misalignment and minimize the possibility of being blown over by weather conditions or traffic.

On new location projects and on projects where either horizontal or vertical alignments has been modified, the location of No-Passing Zones will be identified by the Engineer.

c. EDGELINES

1) Bituminous Surface Treatment Paving

Edgelines will not be required on intermediate surfaces (including asphaltic concrete leveling for bituminous surface treatment paving) that are in use for a period of less than 60 calendar days except at bridge approaches, on lane transitions, lane shifts, and in such other areas as determined by the Engineer. On the final surface, edgelines shall be placed within 30 calendar days of the time that the final surface was placed.

2) All Other Types of Pavement

Edgelines will not be required on intermediate surfaces that are in use for a period of less than 30 calendar days except at bridge approaches, on lane transitions, lane shifts, and in such other areas as determined by the Engineer. On the final surface, edgelines shall be placed within 14 calendar days of the time that the surface was placed.

2. Multi-Lane Highways – With No Paved Shoulder(S) Or Paved Shoulder(S) Four Feet Or Less

a. UNDIVIDED HIGHWAYS (INCLUDES PAVED CENTER TURN LANE)

1) Centerlines and No-Passing Barrier-Full Pattern centerlines and no-passing barriers shall be restored before opening to traffic.

2) Lanelines- Interim skip (broken) stripe as described in [Subsection 150.04E.1.a.](#) may be used for periods not to exceed three calendar days. Skiplines are not permitted in lane shift areas. Solid lines shall be used.

3) Edgelines- Edgelines shall be placed on intermediate and final surfaces within three calendar days of obliteration.

b. DIVIDED HIGHWAYS (GRASS OR RAISED MEDIAN)

- 1) Lanelines- Full pattern skip stripe shall be restored before opening to traffic. Skip lines are not permitted in lane shift areas. Solid lines shall be required.
- 2) Centerline/Edgeline- Solid lines shall be placed on intermediate and final surfaces within three calendar days of obliteration.

3. Limited Access Roadways And Roadways With Paved Shoulders Greater Than Four Feet

a. Same as [Subsection 150.04.E.2](#) except as noted in (b) below.

b. EDGELINES-

- 1) Asphaltic Concrete Pavement- Edgelines shall be placed on intermediate and final surfaces prior to opening to traffic.
- 2) Portland Cement Concrete Pavement- Edgelines shall be placed on any surface open to traffic no later than one calendar day after work is completed on a section of roadway. All water and residue shall be removed prior to daily striping.

4. Ramps For Multi-Lane Divided Highways

A minimum of one solid line edge stripe shall be placed on any intermediate surface of a ramp prior to opening the ramp to traffic. The other edge stripe may be omitted for a maximum period of three (3) calendar days on an intermediate surface. Appropriate channelization devices shall be spaced at a maximum of twenty-five (25') feet intervals until the other stripe has been installed.

The final surface shall have both stripes placed prior to opening the ramp to traffic.

5. MISCELLANEOUS PAVEMENT MARKINGS:

FINAL SURFACE: School zones, railroads, stop bars, symbols, words and other similar markings shall be placed on final surfaces conforming to [Section 652](#) within fourteen (14) calendar days of completion of the final surface. Final markings shall conform to the type of pay item in the plans. When no pay item exists in the plans the final markings shall conform to [Section 652](#) for painted markings.

INTERMEDIATE SURFACE: Intermediate surfaces that will be in use for more than forty-five (45) calendar days shall have the miscellaneous pavement markings installed to conform to the requirement of [Section 652](#). Under Subsection 150.11, Special Conditions, or as directed by the Engineer these markings may be eliminated.

F. MOBILE OPERATIONS

When pavement markings (centerlines, lane lines, and edgelines) are applied in a continuous operation by moving vehicles and equipment, the following minimum equipment and warning devices shall be required. These devices and equipment are in addition to the minimum requirements of the MUTCD.

1. All Roadways

All vehicles shall be equipped with the official slow moving vehicle symbol sign. All vehicles shall have a minimum of two flashing or rotating beacons visible in all directions. All protection vehicles shall have an arrow panel mounted on the rear. All vehicles requiring an arrow panel shall have, as a minimum, a Type B panel. All vehicle mounted signs shall be mounted with the bottom of the sign a minimum height of forty-eight inches (48") above the pavement. All sign legends shall be covered or removed from view when work is not in progress.

2. Two-Lane Two-Way Roadways

a. Lead Vehicles

The lead vehicle may be a separate vehicle or the work vehicle applying the pavement markings may be used as the lead vehicle. The lead vehicle shall have an arrow panel mounted so that the panel is easily visible to oncoming (approaching) traffic. The arrow panel should typically operate in the caution mode.

b. Work Vehicles

The work vehicle(s) applying markings shall have an arrow panel mounted on the rear. The arrow panel should typically operate in the caution mode. The work vehicle placing cones shall follow directly behind the work vehicle applying the markings.

c. Protection Vehicles

A protection vehicle may follow the cone work vehicle when the cones are being placed and may follow when the cones are being removed.

3. MULTI-LANE ROADWAYS

A lead vehicle may be used but is not required. The work vehicle placing cones shall follow directly behind the work vehicle applying the markings. A protection vehicle that does not function as a work vehicle should follow the cone work vehicle when traffic cones are being placed. A protection vehicle should follow the cone work vehicle when the cones are being removed from the roadway. Protection vehicles shall display a sign on the rear of the vehicle with the legend PASS ON LEFT (RIGHT).

INTERSTATES AND LIMITED ACCESS ROADWAYS: A protection vehicle shall follow the last work vehicle at all times and shall be equipped with a truck mounted attenuator that is certified for impacts not less than 62 mph in accordance with NCHRP350 Test Level Three (3).

150.05 CHANNELIZATION

A. GENERAL

Channelization shall clearly delineate the travelway through the work zone and alert drivers and pedestrians to conditions created by work activities in or near the travelway. Channelization shall be done in accordance with the plans and specifications, the MUTCD, and the following requirements.

All Channelization Devices utilized on any project shall be NCHRP 350 compliant. Any device used on the Work shall be from the Qualified Products List. All devices utilized on the work shall have a decal, logo, or manufacturer's stamping that clearly identifies the device as NCHRP 350 compliant. The Contractor may be required to furnish certification from the Manufacturer for any device to prove NCHRP 350 compliance.

1. Types of Devices Permitted for Channelization in Construction Work Zones:

a. DRUMS:

- 1) **DESIGN:** Drums shall meet the minimum requirement of the MUTCD and shall be reflectorized as required in [Subsection 150.01.D](#). The upper edge of the top reflectorized stripe on the drum shall be located a minimum of 33 inches above the surface of the roadway. A minimum drum diameter of 18 inches shall be maintained for a minimum of 34 inches above the roadway.
- 2) **APPLICATION:** Drums shall be used as the required channelizing device to delineate the full length of a lane closure, shift, or encroachment, except as modified by this Subsection.
- 3) **TRANSITION TAPERS FOR LANE CLOSURES:** Drums shall be used on all transition tapers. The minimum length for a merging taper for a lane closure on the travelway shall be as shown in Table 150-1:

TABLE 150-1

Posted Speed Limit, MPH	Lane Width 9 Feet	Lane Width 10 Feet	Lane Width 11 Feet	Lane Width 12 Feet	Maximum Drum Spacing in Tapers, (Feet)
	Minimum Taper Length (L) in Feet				
20	60	70	75	80	20
25	95	105	115	125	25
30	135	150	165	180	30
35	185	205	225	245	35
40	240	270	295	320	40
45	405	450	495	540	45
50	450	500	550	600	50
55	495	550	605	660	55
60	540	600	660	720	60
65	585	650	715	780	65
70	630	700	770	840	70
75	675	750	825	900	75

If site conditions require a longer taper then the taper shall be lengthened to fit particular individual situations.

The length of shifting tapers should be at least 1/2 L.

The length of a closed lane or lanes, excluding the transition taper(s), shall be limited to a total of two (2) miles. Prior approval must be obtained from the Engineer before this length can be increased.

Night time conditions: When a merge taper exists into the night all drums located in the taper shall have, for the length of the taper only, a six (6") inch fluorescent orange (ASTM Type VI, VII, VIII, IX or X) reflectorized top stripe on each drum. The top six-inch stripe may be temporarily attached to the drum while in use in a taper. The Engineer may allow the fluorescent orange reflectorized six (6") inch top stripe on each drum in a merging taper to remain in place during daylight hours provided there is a lane closure(s) with a continuous operation that begins during one nighttime period and ends during another nighttime period. All drums that have the six-inch top stripe permanently attached shall not be used for any other conditions.

Multiple Lane Closures:

- (a) A maximum of one lane at a time shall be closed with each merge taper.
 - (b) A minimum tangent length of 2 L shall be installed between each individual lane closure taper.
- 4) LONGITUDINAL CHANNELIZATION: Drums shall be spaced as listed below for various roadside work conditions except as modified by

[Subsection 150.06](#). Spacing shall be used for situations meeting any of the conditions listed as follows:

(a) 40 FOOT SPACING MAXIMUM

- (1) For difference in elevation exceeding two inches.
- (2) For heeled sections no steeper than 4:1 as shown in [Subsection 150.06](#), [Detail 150-E](#).

(b) 80 FOOT SPACING MAXIMUM

- (1) For difference in elevation of two inches or less.
- (2) Flush areas where equipment or workers are within ten feet of the travel lane.

(c) 200 FOOT SPACING MAXIMUM: Where equipment or workers are more than ten feet from travel lane. Lateral offset clearance to be four feet from the travel lane.

- (1) For paved areas eight feet or greater in width that are paved flush with a standard width travel lane.
- (2) For disturbed shoulder areas not completed to typical section that are flush to the travel lane and considered a usable shoulder.

REMOVAL OF DRUMS: Drums may be removed after shoulders are completed to typical section and grassed. Guardrail and other safety devices shall be installed and appropriate signs advising of conditions such as soft or low shoulder shall be posted before the drums are removed.

b. VERTICAL PANELS

- 1) DESIGN: All vertical panels shall meet the minimum requirements of the MUTCD. All vertical panels shall have a minimum of 270 square inches of retro-reflective area facing the traffic and shall be mounted with the top of the reflective panel a minimum of 36" above the roadway.
- 2) APPLICATION: Lane encroachment by the drum on the travelway should permit a remaining lane width of ten feet. When encroachment reduces the travelway to less than ten feet, vertical panels shall be used to restore the travelway to ten feet or greater. No other application of vertical panels will be permitted.

c. CONES

- 1) DESIGN: All cones shall be a minimum of 28 inches in height regardless of application and shall meet the requirement of the MUTCD. Reflectorization may be deleted from all cones.

- 2) APPLICATION: For longitudinal channelizing only, cones will be permitted for daylight closures or minor shifts. (Drums are required for all tapers.) The use of cones for nighttime work will not be permitted. Cones shall not be stored or allowed to be visible on the worksite during nighttime hours.

d. BARRICADES

DESIGN: Type III barricades shall meet the minimum requirements of the MUTCD and shall be reflectorized as required in [Subsection 150.01.D](#). The Contractor has the option of choosing Type III barricades from the Qualified Products List or the Contractor may utilize generic barricades that are approved by the Federal Highway Administration (FHWA). When barricades have been specifically crash tested with signs attached, the contractor has the responsibility to attach the signs as per the manufacturer's recommendations to ensure crashworthiness. If signs are attached to generic barricades or to barricades from the Qualified Products List (QPL) that have not been crash tested with signs attached then the responsibility for crashworthiness and the liability for mounting these signs to the barricades are assumed by the Contractor and the Contractor shall certify that the barricades are crashworthy under FHWA workzone guidelines for NCHRP 350 crashworthy compliance. Any generic barricades used in the work shall be stamped or stenciled to show compliance with NCHRP 350. The use of Type I and Type II barricades will not be permitted.

- 1) APPLICATION: Type III barricades shall be placed as required by the plans, the Standards, and as directed by the Engineer. All signs mounted on barricades shall be mounted to comply with the requirements of the MUTCD and NCHRP 350 Test Level III. NCHRP 350 crashworthy compliance may require that rigid signs be mounted separate from the Type III barricade.

When a barricade is placed so that it is subject to side impact from a vehicle, a drum shall be placed at the side of the barricade to add target value to the barricade.

e. WARNING LIGHTS:

- 1) DESIGN: All warning lights shall meet the requirements of the MUTCD.

- 2) APPLICATION

- (a) Type A low-intensity flashing lights shall be used as shown in the Plans, the Standards, and as directed by the Engineer. Flashing lights are not required for advance warning signs in [Subsection 150.03.H](#).

- (b) Type C Steady-Burn lights shall be used as shown in the Plans, the Standards, and as directed by the Engineer. Steady-burn lights are not required on drums for merging tapers that exist into the night.

f. TEMPORARY BARRIERS

- 1) DESIGN: Temporary barriers shall meet the requirements of Sections 620.
- 2) APPLICATION: Temporary barriers shall be placed as required by the plans, standards, and as directed by the Engineer. When Temporary barrier is located 20 feet or less from a travel lane, yellow reflectors shall be fixed to the top of the barrier at intervals not greater than 40 feet in the longitudinal section and 20 feet in the taper section and shall be mounted approximately two inches above the barrier. If both lanes of a two-lane two-way roadway are within 20 feet or less of the barrier then the reflectors shall be installed for both directions of traffic.

The reflectors shall be 100 square inches (ASTM Type VII or VIII) reflective sheeting mounted on flat-sheet blanks. The reflectors shall be mounted approximately two inches above the top of the barrier. The reflectors shall be attached to the barrier with adhesive or by a drilled-in anchor type device. The reflectors shall not be attached to a post or board that is placed between the gap in the barrier sections.

Approach end of Temporary barrier shall be flared or protected by an impact attenuator (crash cushion) or other approved treatment in accordance with Construction Details/Standards and Standard Specifications.

On interstate or other controlled access highways where lane shifts or crossovers cause opposing traffic to be separated by less than 40 ft., portable barrier shall be used as a separator.

B. PORTABLE IMPACT ATTENUATORS:

1. DESCRIPTION

This work consists of the furnishing (including spare parts), installation, maintenance, relocation, reuse as required, and removal of Portable Impact Attenuator Units/Arrays.

2. MATERIALS

Materials used in the Attenuator shall meet the requirements of [Section 648](#) for Portable Impact Attenuators.

3. CONSTRUCTION

Portable Impact Attenuator Unit/Arrays installation shall conform to the requirements of [Section 648](#), Manufacturer's recommendations and Georgia Standard 4960 and shall be installed at locations designated by the Engineer, and/or as shown on the plans.

C. TEMPORARY GUARDRAIL ANCHORAGE- Type 12:

1. DESCRIPTION

This work consists of the furnishing, installation, maintenance and removal of Temporary Guardrail Anchorage- Type 12 used for Portable Barrier or temporary guardrail end treatment.

2. MATERIALS

Materials used in the Temporary Guardrail Anchorage- Type 12 shall meet the requirements of [Subsection 641.2](#) of the Specifications and current Georgia Standards and may be new or used. Materials salvaged from the Project which meet the requirements of Standards may be utilized if available. The use of any salvaged materials will require prior approval of the Engineer.

3. CONSTRUCTION

Installation of the Temporary Guardrail Anchorage- Type 12 shall conform to the requirements of the Plans, current Georgia Standards and [Subsection 641.3](#) of the Specifications. Installation shall also include sufficient additional guardrail and appurtenances to effect the transition and connection to Temporary Concrete Barrier as required by the details in Georgia Standard 4960.

150.06 DIFFERENCES IN ELEVATION BETWEEN TRAVEL LANES AND SHOULDERS (SEE [SUBSECTION 150.06.G](#) FOR PROJECTS CONSISTING PRIMARILY OF ASPHALTIC CONCRETE RESURFACING ITEMS)

Any type of work such as paving, grinding, trenching, or excavation that creates a difference in elevation between travel lanes or between the travelway and the shoulder shall not begin until the Contractor is prepared and able to continuously place the required typical section to within two inches (2") of the existing pavement elevation. For any areas that the two inches minimum difference in elevation cannot be accomplished the section shall be healed as shown in [Detail 150-E](#). If crushed stone materials are used to provide a healed section no separate payment will be made for the material used to heal any section. The Contractor may submit a plan to utilize existing pay items for crushed stone provided the plan clearly demonstrates that the materials used to heal an area will be incorporated into the work with minimal waste. Handling and hauling of any crushed stone used to heal shall be kept to a minimum. The Engineer shall determine if the crushed stone used to heal meets the specifications for gradation and quality when the material is placed in the final location.

A maximum of sixty (60) calendar days shall be allowed for conditions to exist that require any section or segment of the roadway or ramp to continue to require a healed section as described by [Detail 150-E](#). Failure to meet this requirement shall be considered as non-performance of Work under [Subsection 150.08](#).

When trenching or excavation for minor roadway or shoulder widening is required, all operations at one site shall be completed to the level of the existing pavement in the same work day.

Any channelization devices utilized in the work shall conform to the requirements of [Subsection 150.05](#) and to the placement and spacing requirements in [Details 150-B](#), [150-C](#), [150-D](#), and [150-E](#) shown in this section.

Any construction activity that reduces the width of a travel lane shall require the use of a W-20 sign with the legend "LEFT/RIGHT LANE NARROWS". Two 24" x 24" red or red/orange flags may be mounted above the W-20 sign. The W-20 sign shall be located on the side of the travelway that has been reduced in width just off the travelway edge of pavement. The W-20 sign shall be a minimum of 500 feet in advance of any channelization devices that encroach on the surface of travelway. A portable changeable message sign may be used in lieu of the W-20 sign.

GENERAL/TIME RESTRICTIONS:

A. STONE BASES, SOIL AGGREGATE BASE AND SOIL BASES

1. All Highways

Differences in elevation of more than two inches between surfaces carrying or adjacent to traffic will not be allowed for more than a 24-hour period. A single length of excavated area that does not exceed 1000 feet in total length may be left open as a start up area for periods not to exceed 48 hours provided the Contractor can demonstrate the ability to continuously excavate and backfill in a proficient manner. Prior approval of the Engineer shall be obtained before any startup area may be allowed.

2. LIMITED ACCESS HIGHWAY RAMPS (INTERSTATES):

On projects that include ramp rehabilitation work, one ramp at a time may be excavated for the entire length of the ramp from the gore point of the ramp with the interstate mainline to the intersection with the crossing highway. This single ramp may remain excavated with a vertical difference in elevation greater than two (2") inches for a maximum of fourteen (14) calendar days with drums spaced at twenty (20') feet intervals as shown in Detail 150-B and a buffer space accepted under Section 150.06.F. After fourteen (14) calendar days the section shall be healed as required for all other highways. This area will be allowed in addition to the 1000 feet allowed for all other highways.

B. ASPHALT BASES, BINDERS AND TOPPING

1. DIFFERENCES IN ELEVATION BETWEEN THE SURFACES OF ADJACENT TRAVELWAYS

Travel lanes shall be paved with a plan that minimizes any difference in elevation between adjacent travel lanes. The following limitations will be required on all work:

- a. Differences of two inches (2") or less may remain for a maximum period of fourteen (14) calendar days.
- b. Differences of greater than two inches (2") shall be permitted for continuous operations only.

EMERGENCY SITUATIONS: Inclement weather, traffic accidents, and other events beyond the control of the Contractor may prevent the work from being completed as required above. The Contractor shall notify the Engineer in writing stating the conditions and reasons that have prevented the Contractor from complying with the time limitations. The Contractor shall also outline a plan detailing immediate steps to complete the work. Failure to correct these conditions on the first calendar day that conditions will allow corrective work shall be considered as non-performance of Work under [Subsection 150.08](#).

2. Differences in Elevation Between Asphalt Travelway and Paved Shoulders

Differences in elevation between the asphalt travelway and asphalt paved shoulders shall not be allowed to exist beyond the maximum durations outlined below for the conditions shown in [Details 150-B](#), [150-C](#), [150-D](#), and [150-E](#):

Detail 150-B conditions shall not be allowed for more than 24 hours. A single length that does not exceed 1000 feet in total length may be left open for periods not to exceed 48 hours provided the Contractor can demonstrate the ability to continuously pave in a proficient manner. Prior approval of the Engineer shall be obtained before any section is allowed to exceed 24 hours. Any other disturbed shoulder areas shall be healed as in [Detail 150-E](#).

[Detail 150-C](#) conditions will not be allowed for more than 48 hours.

[Detail 150-D](#) conditions will not be allowed for more than 30 calendar days.

[Detail 150-E](#) conditions will not be allowed for more than 60 calendar days.

Failure to meet these requirements shall be considered as non-performance of Work under [Subsection 150.08](#).

C. PORTLAND CEMENT CONCRETE

Work adjacent to a Portland Cement Concrete traveled way which involves the following types of base and shoulders shall be accomplished according to the time restrictions outlined for each type of base or shoulder. Traffic control devices shall be in accordance with [Subsection 150.05](#).

1. Cement Stabilized Base

Work adjacent to the traveled way shall be healed as per [Detail 150-E](#) within forty-eight (48) hours after the seven (7) calendar day curing period is complete for each section placed. During the placement and curing period, traffic control shall be in accordance [Detail 150-B](#).

2. Asphaltic Concrete Base

When an asphaltic concrete base is utilized in lieu of a cement stabilized base the asphaltic concrete base shall be healed as per [Detail 150-E](#) within forty-eight (48) hours after the placement of each section of asphaltic concrete base. For the first forty eight hours traffic control shall be in compliance with [Detail 150-B](#).

3. Concrete Paved Shoulders

Concrete paved shoulders shall be placed within sixty (60) calendar days after the removal of each section of existing shoulder regardless of the type of base materials being placed on the shoulders. During the placement period, traffic control devices shall be in accordance with the appropriate detail based on the depth of the change in elevation. Differences in elevation of more than two inches between the travel way and the shoulder will not be allowed for more than a 24-hour period. A single length of excavated area that does not exceed 1000 feet in total length may be left open as a start up area for periods not to exceed 48 hours provided the Contractor can demonstrate the ability to continuously excavate and backfill in a proficient manner. Prior approval of the Engineer shall be obtained before any startup area may be allowed. Any other disturbed shoulder areas shall be healed as in [Detail 150-E](#).

4. Asphaltic Concrete Shoulders

A difference in elevation that meets the requirements of [Detail 150-B](#) shall not be allowed to exist for a period greater than forty-eight (48) hours. After the removal of the existing shoulder the section or segment of travelway may be healed with stone as per [Detail 150-E](#) for a maximum of fourteen (14) calendar days. Asphaltic concrete shoulders shall be placed within two (2") inches or less of the traveled way surface within fourteen (14) calendar days after the removal of the stone healed section or the removal of each section of the existing shoulder. The two (2") inches or less difference in elevation shall not remain in existence for a period that exceeds thirty (30) calendar days unless the paved shoulder is utilized as a detour for the traveled way. During the placement period, traffic control shall be in accordance with the appropriate detail based on the depth of the change in elevation.

The Contractor may propose an alternate plan based on [Subsection 150.06.F](#). Failure to meet the above requirements and time restrictions shall be considered as non-performance of Work under [Subsection 150.08](#).

D. MISCELLANEOUS ELEVATION DIFFERENTIALS FOR EXCAVATIONS ADJACENT TO THE TRAVELWAY

Drainage structures, utility facilities, or any other work which results in a difference in elevation adjacent to the travelway shall be planned and coordinated to be performed in such a manner to minimize the time traffic is exposed to this condition. The excavation should be back filled to the minimum requirements of [Detail 150-E](#) as soon as practical. Stage construction such as plating or backfilling the incomplete work may be required. The difference in elevation shall not be allowed to exist for more than five (5) calendar days under

any circumstances. Failure to correct this condition shall be considered as non-performance of Work under [Subsection 150.08](#).

E. CONDUIT INSTALLATION IN PAVED AND DIRT SHOULDERS

The installation of conduit and conduit systems along the shoulders of a traveled way shall be planned and installed in a manner to minimize the length of time that traffic is exposed to a difference in elevation condition. The following restrictions and limitations shall apply:

1. Differences in Elevation of Two (2") Inches or Less

The shoulder may remain open when workers are not present. When workers are present the shoulder shall be closed and the channelization devices shall meet the requirements of [Subsection 150.05](#). The difference in elevation on the shoulder shall remain for a maximum period of fourteen (14) calendar days.

2. Differences in Elevation Greater Than Two (2") Inches

The shoulder shall be closed. The shoulder closure shall not exceed twenty-four (24) hours in duration unless the Special Conditions in Subsection 150.11 modifies this restriction or the Engineer allows the work to be considered as a continuous operation.

Failure to meet these requirements shall be considered as non-performance of Work under [Subsection 150.08](#).

F. MODIFICATIONS TO TIME RESTRICTIONS

The Contractor may propose any alternate temporary traffic control plan that utilizes a portion of the travel lane as a "buffer space". This buffer space may allow for an enhanced work area that will allow for the placement of materials to proceed at a pace that could not be achieved with the time restriction requirements outlined in [Section 150.06.A](#), [150.06.B](#), and [150.06.C](#). The Contractor may propose modified time restrictions based on the use of the buffer space. Any proposed modifications in the time duration allowed for the differences in elevations to exist shall be reviewed by the Engineer as a component of the overall TTC plan. No modifications shall be made until the proposed plan is accepted by the Engineer. The Engineer shall have no obligation to consider any proposal which results in an increase in cost to the Department.

For the travel lane described in each of the [details 150-B](#), [150-C](#), [150-D](#) and [150-E](#) it is presumed that the pavement marking edgeline (yellow or white solid stripe) is located at the very edge of the travel lane surface. A buffer space (temporary paved shoulder) that utilizes a portion of the travel lane should be six (6') feet in width desirable but shall not be less than four (4') feet in width. Any remaining travel lane(s) shall not be less than ten (10') feet in width. Modifications to drum spacing shown in the details above will not be allowed.

If the proposed shifting of the traffic to obtain a buffer space and maintain a minimum travel lane(s) of ten (10') feet requires the use of any existing paved shoulders then the cost of maintenance and repair of the existing paved shoulder(s) shall be the responsibility of the Contractor. The Contractor is responsible for the costs of maintenance and repairs even if the existing paved shoulder(s) is to be removed in a later stage of the work. Existing shoulders that have rumble strips shall have the rumble strips removed before the shoulder can be utilized as part of the travel lane. The cost of the removal of the rumble strips shall be done at no cost to the Department even if the shoulder is to be removed in a later stage of the work.

Any modifications to the staging and time restrictions that are approved as part of the TTC plan shall be agreed to in writing. Failure to meet these modifications shall be considered as non-performance of the Work under [Subsection 150.08](#).

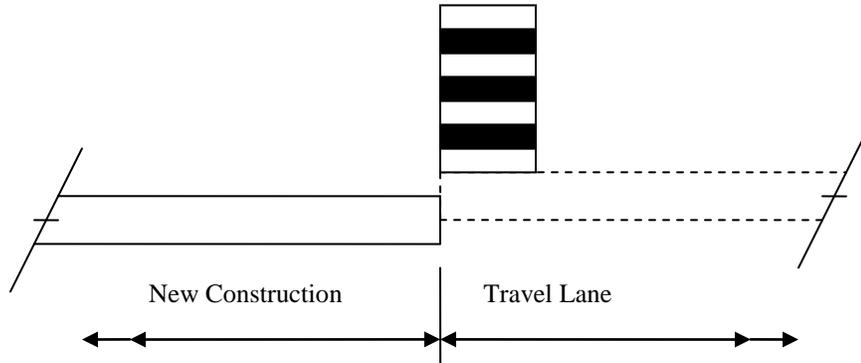
G. ASPHALTIC CONCRETE RESURFACING PROJECTS

SHOULDER CONSTRUCTION INCLUDED AS A PART OF THE CONTRACT: When the placement of asphaltic concrete materials creates a difference in elevation greater than two (2") inches between the earth shoulder (grassed or un-grassed) and the edge of travelway or between the earth shoulder and a paved shoulder that is less than four (4') feet in width, the Contractor shall place and maintain drums in accordance with the requirements of [Subsection 150.05A.1.a.4](#)). When the edge of the paved surface is tapered with a 30-45 degree wedge, drums may be spaced at 2.0 times the speed limit in MPH. Drums shall remain in place and be maintained until the difference in elevation has been eliminated by the placement of the appropriate shoulder materials.

SHOULDER CONSTRUCTION NOT INCLUDED AS A PART OF THE CONTRACT: When the placement of asphaltic concrete materials creates a difference in elevation greater than two (2") inches between the earth shoulder (grassed or un-grassed) and the edge of travelway or between the earth shoulder and a paved shoulder that is less than four (4') feet in width, the Contractor shall notify the Engineer, in writing, when the resurfacing work including all punchlist items has been completed.

See [Subsection 150.03.L](#) for the requirements for "LOW/SOFT SHOULDERS" and "SHOULDER DROP-OFF" signage.

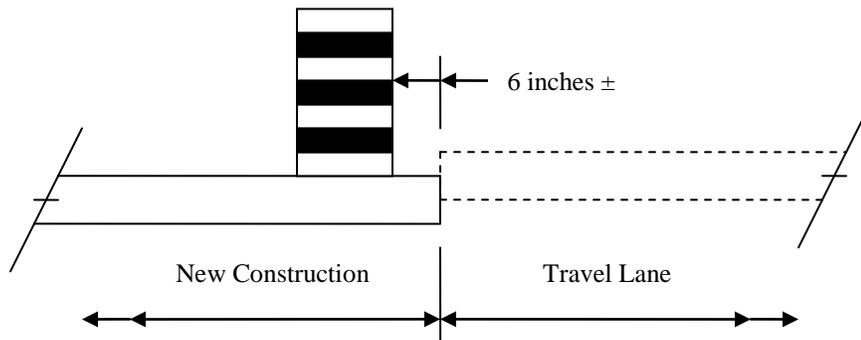
Location of drums when Elevation Difference exceeds 4 inches. Drums spaced at 20 foot intervals. Note: If the travel way width is reduced to less than 10 feet by the use of drums, vertical panels shall be used in lieu of drums.	
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ELEVATION DIFFERENCE GREATER THAN 4 INCHES

DETAIL 150-B

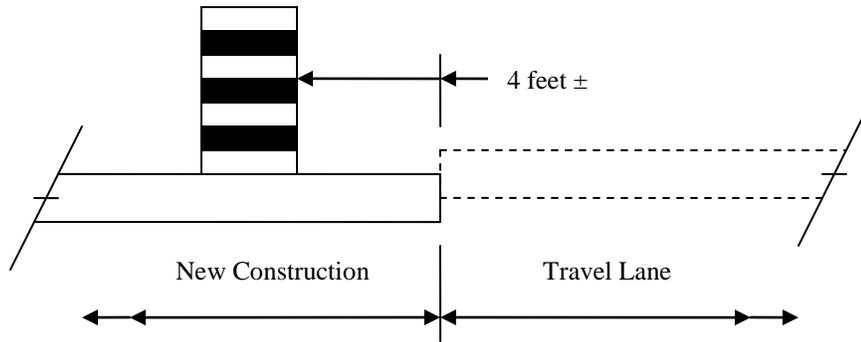
Drums spaced at 40 foot intervals.	Location of drums when Elevation Difference is 2+ inches to 4 inches.
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ELEVATION DIFFERENCE 2+ to 4 inches

DETAIL 150-C

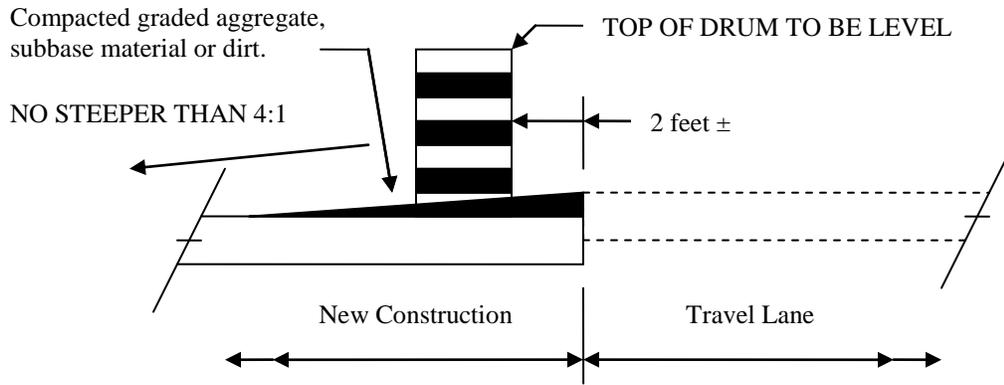
Drums spaced at 80 foot intervals.	Location of drums when Elevation Difference is 2 inches or less.
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ELEVATION DIFFERENCE OF 2 INCHES OR LESS

DETAIL 150-D

	Location of drums immediately after completion of healed sections spaced at 40 foot intervals.
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HEALED SECTION

DETAIL 150-E

150.07 FLAGGING AND PILOT CARS:

A. FLAGGERS

Flaggers shall be provided as required to handle traffic, as specified in the Plans or Special Provisions, and as required by the Engineer.

B. FLAGGER CERTIFICATION

All flaggers shall meet the requirements of the MUTCD and shall have received training and a certificate upon completion of the training from one of the following organizations:

National Safety Council
Southern Safety Services
Construction Safety Consultants
Ivey Consultants
American Traffic Safety Services Association (ATSSA)

Certifications from other agencies will be accepted only if their training program has been approved by any one of the organizations listed above.

Failure to provide certified flaggers as required above shall be reason for the Engineer suspending work involving the flagger(s) until the Contractor provides the certified flagger(s). Flaggers shall have proof of certification and valid identification (photo I.D.) available any time they are performing flagger duties.

C. FLAGGER APPEARANCE AND EQUIPMENT

Flaggers shall wear high-visibility clothing in compliance with [Subsection 150.01.A](#). The apparel background (outer) material color shall be fluorescent orange-red, fluorescent yellow-green, or a combination of the two as defined in the ANSI standard. The retroreflective material shall be orange, yellow, white, silver, yellow-green, or a fluorescent version of these colors, and shall be visible at a minimum distance of one thousand (1000) feet. The retroreflective safety apparel shall be designed to clearly identify the wearer as a person. They shall use a Stop/Slow paddle meeting the requirements of the MUTCD for controlling traffic. The Stop/Slow paddles shall have a shaft length of seven (7) feet minimum. The Stop/Slow paddle shall be retro-reflectorized for both day and night usage. In addition to the Stop/Slow paddle, a flagger may use a flag as an additional device to attract attention. This flag shall meet the minimum requirements of the MUTCD. The flag shall, as a minimum, be 24" inches square and red or red/orange in color. For night work, the vest shall have reflectorized stripes which meet the requirements of the MUTCD.

D. FLAGGER WARNING SIGNS

Signs for flagger traffic control shall be placed in advance of the flagging operation in accordance with the MUTCD. In addition to the signs required by the MUTCD, signs at regular intervals, warning of the presence of the flagger shall be placed beyond

the point where traffic can reasonably be expected to stop under the most severe conditions for that day's work.

E. PILOT VEHICLE REQUIREMENTS

Pilot vehicles will be required during placement of bituminous surface treatment or asphaltic concrete on two-lane roadways unless otherwise specified. Pilot vehicles shall meet the requirements of the MUTCD.

F. PORTABLE TEMPORARY TRAFFIC CONTROL SIGNALS

The Contractor may request, in writing, the substitution of portable temporary traffic control signals for flaggers on two-lane two-way roadways provided the temporary signals meets the requirements of the MUTCD, [Section 647](#), and [Subsection 150.02.A.8](#). As a part of this request, the Contractor shall also submit an alternate temporary traffic control plan in the event of a failure of the signals. Any alternate plan that requires the use of flaggers shall include the use of certified flaggers. The Contractor shall obtain the approval of the Engineer before the use of any portable temporary traffic control signals will be permitted.

150.08 ENFORCEMENT

The safe passage of pedestrians and traffic through and around the temporary traffic control zone, while minimizing confusion and disruption to traffic flow, shall have priority over all other Contractor activities. Continued failure of the Contractor to comply with the requirements of Section 150 (TRAFFIC CONTROL) will result in non-refundable deductions of monies from the Contract as shown in this Subsection for non-performance of Work.

Failure of the Contractor to comply with this Specification shall be reason for the Engineer suspending all other work on the Project, except erosion control and traffic control, taking corrective action as specified in [Subsection 105.15](#), and/or withholding payment of monies due to the Contractor for any work on the Project until traffic control deficiencies are corrected. These other actions shall be in addition to the deductions for non-performance of traffic control.

SCHEDULE OF DEDUCTIONS FOR EACH CALENDAR DAY OF DEFICIENCIES OF TRAFFIC CONTROL INSTALLATION AND/OR MAINTENANCE		
ORIGINAL TOTAL CONTRACT AMOUNT		
From More Than	To and Including	Daily Charge
\$0	\$100,000	\$200
\$100,000	\$1,000,000	\$500
\$1,000,000	\$5,000,000	\$1,000
\$5,000,000	\$20,000,000	\$1,500
\$20,000,000	\$40,000,000	\$2,000
\$40,000,000	\$-----	\$3,000

150.09 MEASUREMENT

A. TRAFFIC CONTROL

When listed as a pay item in the Proposal, payment will be made at the Lump Sum price bid, which will include all traffic control not paid for separately, and will be paid as follows:

When the first Construction Report is submitted, a payment of 25 (twenty-five) percent of the Lump Sum price will be made. For each progress payment thereafter, the total of the Project percent complete shown on the last pay statement plus 25 (twenty-five) percent will be paid (less previous payments), not to exceed one hundred (100) percent.

When no payment item for *Traffic Control-Lump Sum* is shown in the Proposal, all of the requirements of Section 150 and the Temporary Traffic Control Plan shall be in full force and effect. The cost of complying with these requirements will not be paid for separately, but shall be included in the overall bid submittal.

B. SIGNS

When shown as a pay item in the contract, interim special guide signs will be paid for as listed below. All other regulatory, warning, and guide signs, as required by the Contract, will be paid for under Traffic Control Lump Sum or included in the overall bid submitted.

1. Interim ground mounted or interim overhead special guide signs will be measured for payment by the square foot. This payment shall be full compensation for furnishing the signs, including supports as required, erecting,

illuminating overhead signs, maintaining, removing, re-erecting, and final removal from the Project. Payment will be made only one time regardless of the number of moves required.

2. Remove and reset existing special guide signs, ground mount or overhead, complete, in place, will be measured for payment per each. Payment will be made only one time regardless of the number of moves required.
3. Modify special guide signs, ground mount or overhead, will be measured for payment by the square foot. The area measured shall include only that portion of the sign modified. Payment shall include materials, removal from posts or supports when necessary, and remounting as required.

C. TEMPORARY BARRIER

Temporary Barrier shall be measured as specified in [Sections 622](#).

D. CHANGEABLE MESSAGE SIGN, PORTABLE

Changeable Message Sign, Portable will be measured as specified in [Section 632](#).

E. TEMPORARY GUARDRAIL ANCHORAGE, Type 12

Temporary Guardrail Anchorage- Type 12 will be measured by each assembly, complete in place and accepted according to the details shown in the plans, which shall also include the additional guardrail and appurtenances necessary for transition and connection to Temporary Concrete Barrier. Payment shall include all necessary materials, equipment, labor, site preparation, maintenance and removal.

F. TRAFFIC SIGNAL INSTALLATION- TEMPORARY

Traffic Signal Installation- Temporary will be measured as specified in [Section 647](#).

G. FLASHING BEACON ASSEMBLY

Flashing Beacon Assemblies will be measured as specified in [Section 647](#).

H. PORTABLE IMPACT ATTENUATORS

Each Portable Impact Attenuator will be measured by the unit/array which shall include all material components, hardware, incidentals, labor, site preparation, and maintenance, including spare parts recommended by the manufacturer for repairing accident damage. Each unit will be measured only once regardless of the number of locations installed, moves required, or number of repairs necessary because of traffic damage. Upon completion of the project, the units shall be removed and retained by the Contractor.

I. PAVEMENT MARKINGS

Pavement markings will be measured as specified in Section 150.

J. TEMPORARY WALKWAYS WITH DETECTABLE EDGING

Temporary walkways with detectable edging will be measured in linear feet (meters), complete in place and accepted, which shall include all necessary materials, equipment, labor, site preparation, temporary pipes, passing spaces, maintenance and removal. Excavation and backfill are not measured separately for payment. No payment will be made for temporary walkways where existing pavements or existing edging (that meets the requirements of MUTCD) are utilized for the temporary walkway. Payment for temporary detectable edging, including approved barriers and channelizing devices, installed on existing pavement shall be included in Traffic Control-Lump Sum.

K. TEMPORARY CURB CUT WHEELCHAIR RAMPS

Temporary curb cut wheelchair ramps are measured as the actual number formed and poured, complete and accepted, which shall include all necessary materials, equipment, labor, site preparation, maintenance and removal. No additional payment will be made for sawing existing sidewalk and removal and disposal of removed material for temporary wheelchair ramp construction. No additional payment will be made for constructing the detectable warning surface.

L. TEMPORARY AUDIBLE INFORMATION DEVICE

Temporary audible information devices are measured as the actual number furnished and installed in accordance with the manufacturer’s recommendations, which shall include all necessary materials, equipment, labor, site preparation, maintenance and removal. Each temporary audible information device will be paid for only one time regardless of the number of times it’s reused during the duration of The Work. These devices shall remain the property of the Contractor.

150.10 PAYMENT:

When shown in the Schedule of Items in the Proposal, the following items will be paid for separately.

Item No. 150. Traffic Control	Lump Sum
Item No. 150. Traffic Control, Solid Traffic Stripe _ Inch, (Color)....	per Linear Mile
Item No. 150. Traffic Control, Skip Traffic Stripe _ Inch, (Color)	per Linear mile
Item No. 150. Traffic Control, Solid Traffic Stripe, Thermoplastic ____ Inch, (Color)	per Linear Mile
Item No. 150. Traffic Control, Skip Traffic Stripe, Thermoplastic _____ Inch, (Color)	per Linear Mile
Item No. 150. Traffic Control, Pavement Arrow with Raised Reflectors	per Each
Item No. 150. Traffic Control, Raised Pavement Markers-All Types.	per Each

Item No. 150. Interim Ground Mounted Special Guide Signs Foot	per Square
Item No. 150. Interim Overhead Special Guide Signs Foot	per Square
Item No. 150. Remove & Reset Existing Special Guide Signs, Ground Mount, Complete in Place	per Each
Item No. 150. Remove & Reset, Existing Special Guide Signs, Overhead, Complete in Place	per Each
Item No. 150. Traffic Control, Portable Impact Attenuator.....	per Each
Item No. 150. Traffic Control, Pavement Markers, Words and Symbols	per Square
Foot	
Item No. 150. Traffic Control, Pavement Arrow (Painted) with Raised Reflectors	per Each
Item No. 150. Traffic Control, Workzone Law Enforcement.....	per Hour
Item No. 150. Modify Special Guide Sign, Ground Mount..... Foot	per Square
Item No. 150. Modify Special Guide Sign, Overhead..... Foot	per Square
Item No. 150. Temporary Walkways With Detectable Edging.....	per Linear foot
Item No. 150. Temporary Curb Cut Wheelchair Ramps.....	per Each
Item No. 150. Temporary Audible Information Device.....	per Each
Item No. 620. Temporary Barrier.....	per Linear Foot
Item No. 632. Changeable Message Sign, Portable	per Each
Item No. 641. Temporary Guardrail Anchorage, Type 12	per Each
Item No. 647. Traffic Signal Installation, Temp	Lump Sum
Item No. 647. Flashing Beacon Assembly, Structure Mounted	per Each
Item No. 647. Flashing Beacon Assembly, Cable Supported	per Each

May 28, 2003
First Use Date: August 1, 2003
June 10, 2005
May 5, 2006
September 15, 2009

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA**

SPECIAL PROVISION

Section 153 – Field Engineer's Office

Delete Subsection 153.3.05 B.7 and substitute the following:

7. Worktable: Provide a minimum of three (3) standard dimension desks. They shall be provided with a minimum of 1 1/8" (28mm) wood grain laminated tops with 23" (575mm) deep files and heavy-duty steel ball bearing drawers and locking center drawer. Provide one (1) 5' X 3' (1500mmX900mm) adjustable from 0 to 45 degree and 38" (950mm) high drafting table.

Delete Subsection 153.3.05 B.8 and substitute the following:

8. Stools: Provide one (1) posture stool with supportive backrest, waterfall edge seat and instant height lever (26" to 30")(650mm to 750mm). Provide a minimum of five (5) fully braced stackable full 2" (50mm) thick 16"X15" (400mmX375mm) seats with armrests and chrome frames. Provide a minimum of four (4) swivel chairs with arms and a 19"X19" (475mmX475mm) foam cushion and upholstered seat adjustable from 16 1/2" to 20" (415mm to 500mm) high.

Retain Subsection 153.3.05 B.11 and add the following:

Process and pay the monthly bills for all utility services.

Delete Subsection 153.3.05 B.12 and substitute the following:

12. Electric Service: Provide 120/240 volt electric service that meets code.

Delete Subsection 153.3.05 B.15 and substitute the following:

15. Telephone: Provide in each Type 3 building three telephone lines. Provide two voice lines, with rollover capabilities, connected to two handsets (located on either end of the office). Provide separate telephone line for the computer, as directed by the Engineer. Install and maintain these lines for the life of the Project. Provide telephone access to the Local Area Telephone Service (LATS) only for outgoing, credit card, collect and toll free calls. Ensure that the telephones can receive incoming non-collect long distance calls.

Provide with the telephone, an automatic answering system that can give a greeting message, record incoming messages, and activate remotely.

Delete Subsection 153.3.05 C.6 and substitute the following:

6. Outside Electrical Receptacle – Provide a weather-proof, exterior 220-volt electrical receptacle attached to a power source.

Delete Subsection 153.3.05 C.7 and substitute the following:

7. Chain Link Fence – Provide a minimum of 500 feet (150m) of 6 ft. (1.8 m) high chain link fence with an extension arm and barbed wire as specified in Section 643. Equip the fence with matching gates and meeting the requirements of Section 643 and consisting of a double 7 ft. (2.1m) by 6 ft. (1.8 m) and a single 4 ft.(1.2 m) by 6 ft. (1.8 m) gate. Include a positive-type locking devices, padlock and a minimum of two keys for each gate. Ensure the fence encompasses the entire compound.

Delete Subsection 153.3.05 C.8 and substitute the following:

8. Security Light – Provide two 150-watt high-pressure sodium security lights with photoelectric controls. Place as directed by the Engineer.

Delete Subsection 153.3.05 C.9 and substitute the following:

9. Copying Machine – The Contractor shall furnish the Field Office with one copying machine installed and maintained for the life of the Project. The copying machine shall have the capability of making letter-size copies (8 ½” x 11”), legal-size copies (8 ½”x 14”), two-sided copies, at least thirty copies per minute, and possess an auto-feed feature. Furnish all consumable and non-consumable supplies for the life of the Project.

Add the following to Subsection 153.3.05 C:

10. Place and spread 200 tons (181 Mg) of aggregate surface course on the Office grounds where indicated by the Engineer to facilitate parking. Remove aggregate and grass the area upon completion of the Project.
11. Ensure that the Office is supported with concrete blocks with mortar joints and anchored with ten storm-tie-down anchors. Enclose the area between the ground and the bottom of the Office with a vinyl skirting that matches the Office’s siding.
12. Install an alarm system that includes the following items and maintain in good operating condition:

- SRN-2000 Enforced Bionic with NAPCO Magnum Alert 850 – control box or Honeywell Vista-10P Master Control Panel with Honeywell 6150RF keypad or equivalent.
- All doors and windows with wired contacts.
- Outside sirens with wired contacts.
- Tamper-proof box with wired contacts.
- Inside sirens with wired contacts.
- Two smoke and heat detectors.

Tie all of the above equipment to a 24 hour control monitoring system (BRK –2812TH or equivalent). Use a wired keyboard system. Do not use a remote system.

Process and pay the monthly bills for the alarm system and monitoring.

13. Provide two (2) additional 4 drawer locking fireproof file cabinets.

14. Provide one Desktop Computer and Accessories meeting the following minimum requirements:

A. Hardware:

- 1.7 GHz Processor or better
- 1 GB RAM or larger
- 80 GB Hard Drive or larger
- 40X Max, CD-RW
- 64 MB Video memory
- V.90 PCI DataFax Modem w/Voice
- 19" (431 mm) Color Monitor
- Human Input Device (Mouse)
- Standard Windows Keyboard

B. Software:

- MS Windows XP **Professional**
- MS Office XP **Professional**
- MS Outlook (Most Recent Version)
- WinZip
- WS-FTP
- A restore CD

C. Printers:

HP Officejet 6310 All-in-One Printer, Fax, Scanner, Copier or Dell 968w All-in-One Wireless Printer or approved equal connected so that all functions including fax capability are active. Furnish all consumable and non-consumable supplies for the life of the Project.

D. Uninterruptible Power Supply:

- American Power Conversion Corporation Back-UPS ES 650 or Newpoint 750 VA Battery Backup or Equal (minimum 5 Receptacles)

E. DSL or Cable Broadband Internet Service

- Provide DSL Internet Service with static IP address or provide Cable Broadband Internet Service as directed by the Engineer. If Cable Broadband Internet Service is used, the third telephone line shall be used for the fax mode of the printer.

16. Concrete Cylinder Curing Box – The Contractor shall furnish a Concrete Curing Box for any project that requires the placement of concrete. The curing box and its components shall be constructed of non-corroding materials and shall be capable of storing a minimum of 22 test cylinders, 6 inch x 12 inch (150 mm x 300 mm) stored vertically with the lid closed. Additional capacity may be required on large projects at the direction of the Engineer. The curing box shall be equipped with heating/cooling capabilities, automatic temperature control, and a maximum/minimum (high/low) temperature readout. The curing box shall be capable of meeting the moisture and temperature requirements of AASHTO T 23.

Add the following to Subsection 153.3.07:

Retain possession of all items that are required as part of the Field Office when the Engineer determines that these items are no longer needed.

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA**

SPECIAL PROVISION

Section 161—Control of Soil Erosion and Sedimentation

Add the following:

161.1 General Description

This Work includes using control measures shown on the Plans, ordered by the Engineer, or as required during the life of the Contract to control soil erosion and sedimentation through the use of any of the devices or methods referred to in this Section.

161.1.01 Definitions

Certified Personnel— certified personnel are defined as persons who have successfully completed the Level IA certification course approved by the Georgia Soil and Water Conservation Commission. For Department projects the certified person must also have successfully completed the Department's WECS certification course.

Design Professional as defined in the current GAR100002 NPDES permit.

161.1.02 Related References

A. Standard Specifications

[Section 105—Control of Work](#)

[Section 106—Control of Materials](#)

[Section 107—Legal Regulations and Responsibility to the Public](#)

[Section 109—Measurement and Payment](#)

[Section 160—Reclamation of Material Pits and Waste Areas](#)

[Section 162—Erosion Control Check Dams](#)

[Section 163—Miscellaneous Erosion Control Items](#)

[Section 166—Restoration or Alteration of Lakes and Ponds](#)

[Section 170—Silt Retention Barrier](#)

[Section 171—Temporary Silt Fence](#)

[Section 205—Roadway Excavation](#)

[Section 434—Sand Asphalt Paved Ditches](#)

[Section 441—Miscellaneous Concrete](#)

[Section 603—Rip Rap](#)

[Section 700—Grassing](#)

[Section 710—Permanent Soil Reinforcing Mat](#)

[Section 715—Bituminous Treated Roving](#)

[Section 716—Erosion Control Mats \(Blankets\)](#)

Erosion control measures contained in the Specifications include:

Erosion Control Measure	Section
Temporary Check Dams	163.3.05.J
Bituminous Treated Mulch	700.3.05.G
Concrete Paved Ditches	441
Bituminous Treated Roving	715
Erosion Control Mats (Blankets)	716
Erosion Control Check Dams	162
Grassing	700
Maintenance of Temporary Erosion Control Devices	165
Permanent Soil Reinforcing Mat	710
Reclamation of Material Pits and Waste Areas	160
Rip Rap	603
Restoration or Alteration of Lakes and Ponds	166
Sand-Asphalt Ditch Paving	434
Sediment Basin	163.3.05.C
Silt Control Gate	163.3.05.A
Silt Retention Barrier	170
Sod	700.3.05.H & 700.3.05.I
Mulch	163
Temporary Grassing	163.3.05.F
Temporary Silt Fence	171
Temporary Slope Drains	163.3.05.B
Triangular Sediment Barrier	720
Silt Filter Bag	719
Organic & Synthetic Material Fiber Blanket	713

B. Referenced Documents

Erosion and Sedimentation Pollution Control Plans (ESPCP)

161.1.03 Submittals

A. Status of Erosion Control Devices

The Worksite Erosion Control Supervisor (WECS) or certified personnel will inspect the installation and maintenance of the Erosion Control Devices according to [Subsection 167.3.05.B](#) and the ESPCP.

1. Submit all reports to the Engineer within 24 hours of the inspection. Refer to [Subsection 167.3.05.C](#) for report requirements.

2. The Engineer will review the reports and inspect the Project for compliance and concurrence with the submitted reports.
3. The Engineer will notify the WECS or certified personnel of any additional items that should be added to the reports.
4. Items listed in the report requiring maintenance or correction shall be completed within 72 hours.

B. Erosion and Sedimentation Pollution Control Plan

1. Project Plans

An erosion and sedimentation pollution control plan (ESPCP) for the construction of the project will be provided by the Department. The ESPCP will be prepared for the various stages of construction necessary to complete the project.

If the Contractor elects to alter the stage construction from that shown in the plans, it will be the responsibility of the Contractor to have the plans revised and prepared in accordance with the current GAR100002 NPDES permit by a Design Professional to reflect all changes in Staging. This will also include any revisions to erosion and sedimentation control item quantities. If the changes affect the Comprehensive Monitoring Program (CMP), the Contractor will be responsible for any revisions to the CMP as well. Submit revised plans and quantities to the Engineer for review prior to land disturbing activities.

2. Haul Roads, Borrow Pits, Excess Material Pits, etc.

The Contractor is responsible for preparing erosion and sedimentation control plans for construction access roads and or haul roads borrow pits, excess material pits, etc (inside the Right of Way). Prepare these plans for all stages of construction and include the appropriate items and quantities. Submit these plans to the Engineer for review prior to land disturbing activities. These plans are to be prepared by a Design Professional.

If construction of access roads, haul roads, borrow pits, excess material pits, etc., (inside the Right of Way) encroach within the 25 foot (7.6 m) buffer along the banks of all state waters or within the 50 ft. (15 m) buffer along the banks of any state waters classified as a "trout stream", a state water buffer variance must be obtained by the Contractor prior to beginning any land disturbing activity in the stream buffer.

3. Erosion Control for Borrow and Excess Material Pits Outside the Right-of-Way

Erosion control for borrow pits and excess material pits outside the right of way is the responsibility of the Contractor. If borrow or excess material pits require coverage under the National Pollutant Discharge Elimination System permit (NPDES) or other permits or variances are required, submit a copy of all documentation required by the permitting agency to the Engineer. All costs associated with complying with local, state, and federal laws and regulations are the responsibility of the Contractor.

4. Culverts and Pipes

The ESPCP does not contain approved methods to construct a stream diversion or stream diversion channel. The Contractor shall prepare a diversion plan utilizing a Design Professional as defined in the current NPDES permit. See 161.3.05 G for additional information.

5. Temporary Asphalt or Concrete Batch Plants

In addition to the requirements of any applicable specifications, if the Department authorizes the temporary installation and use of any asphalt, concrete or similar batch plants within its right of way, the contractor shall submit an NOI to the Georgia Environmental Protection Division for coverage under the following NPDES permits; The Infrastructure permit for the construction of the plant, and the Industrial permit for the operation of, such a plant. The contractor shall submit the NOIs as both the Owner and the Operator.

161.2 Materials

General Provisions 101 through 150.

161.2.01 Delivery, Storage, and Handling

General Provisions 101 through 150.

161.3 Construction Requirements

161.3.01 Personnel

A. Duties of the Worksite Erosion Control Supervisor

Before beginning Work, designate a Worksite Erosion Control Supervisor (WECS) to initiate, install, maintain, inspect, and report the condition of all erosion control devices as described in Sections 160 through 171 or in the Contract and ESPCP documents. The designee shall submit their qualifications on the Department provided resume form for consideration and approval. The contractor may utilize additional persons having WECS qualifications to facilitate compliance however, only one WECS shall be designated at a time.

The WECS and alternates shall:

- Be an employee of the Prime Contractor.
- Have at least one year of experience in erosion and sediment control, including the installation, inspection, maintenance and reporting of BMPs.
- Successfully completed the Georgia Soil and Water Conservation Commission Certification Course Level IA and the Department's WECS Certification Course.
- Provide phone numbers where the WECS can be located 24 hours a day.

The WECS' duties include the following:

1. Be available or have an approved representative available 24 hours a day and have access to the equipment, personnel, and materials needed to maintain erosion control and flooding control.
2. Inform the Engineer in writing whenever the alternate WECS assumes project responsibilities.
3. Ensure that erosion control deficiencies are corrected within seventy two (72) hours or immediately during emergencies. Deficiencies that interfere with traffic flow, safety or downstream turbidity are to be corrected immediately.
4. During heavy rain, have the construction area patrolled day or night, any day of the week to quickly detect and correct erosion or flooding problems before they interfere with traffic flow, safety, or downstream turbidity.
5. Be on the site within three (3) hours after receiving notification of an emergency prepared to positively respond to the conditions encountered. The Department may handle emergencies without notifying the Contractor. The Department will recover costs for emergency maintenance work according to [Subsection 105.15, "Failure to Maintain Roadway or Structures."](#)
6. Maintain and submit for project record, "As-built" Erosion and Sedimentation Control Plans that supplement and graphically depict EC-1 reported additions and deletions of BMPs. The As-Built plans are to be accessed and retained at a Department facility at all times.
7. Ensure that both the WECS and the alternate meet the criteria of this Subsection.
8. The WECS shall maintain a current certification card for the duration of the project. Recertification of the WECS will be required prior to the expiration date shown on the Certification card in order to remain as Certified Personnel and the WECS for the project.

Failure of the WECS or alternate to perform the duties specified in the Contract, or whose performance, has resulted in a citation being received from a State or Federal Regulatory Agency, e.g. the Georgia Environmental Protection Division, shall result in one or more of the following;

- Suspension of the WECS' certification for a period of not less than 30 days
- Removal of the Contractor's project superintendent in accordance with Sections 105.05 and 108.05 for a period not less than 14 days
- Department wide revocation of the WECS certification for a period of 12 months
- Removal of the Contractor's project superintendent in accordance with Sections 105.05 and 108.05

161.3.02 Equipment

General Provisions 101 through 150.

161.3.03 Preparation

General Provisions 101 through 150.

161.3.04 Fabrication

General Provisions 101 through 150.

161.3.05 Construction

Coordinate the temporary and permanent erosion control provisions in this Specification with the permanent erosion control provisions in the Contract to ensure economical, effective, and continuous erosion control throughout the construction and post-construction periods.

At all times that land disturbing activity is underway, a person meeting the requirements of, "certified person" by the GSWCC (Level IA) must be on the project.

A. Control Dust Pollution

The contractor shall keep dust pollution to a minimum during any of the activities performed on the project. It may be necessary to apply water or other BMPs to roadways or other areas reduce pollution.

B. Perform Permanent or Temporary Grassing

Perform permanent grassing, temporary grassing, or mulching on cut and fill slopes weekly (unless a shorter period is required by Subsection 107.23) during grading operations. When conditions warrant, the Engineer may require more frequent intervals.

Under no circumstances shall the grading (height of cut) exceed the height operating range of the grassing equipment. It is extremely important to obtain a cover, whether it is mulch, temporary grass or permanent grass. Adequate mulch is a must.

When grading operations or other soil disturbing activities have stopped, perform grassing or erosion control as shown in the Plans, as shown in an approved Plan submitted by the Contractor, or as directed by the Engineer.

C. Seed and Mulch

Refer to Subsection [161.3.05.B, "Perform Permanent or Temporary Grassing"](#).

D. Implement Permanent or Temporary Erosion Control

1. Silt fence shown along the perimeter, e.g. right of way, and sediment containment devices, e.g. sediment basins, shall be installed prior to or concurrently with clearing and grubbing operations.
2. Incorporate permanent erosion control features into the Project at the earliest practicable time, e.g. velocity dissipation, permanent ditch protection.
3. Use temporary erosion control measures to address conditions that develop during construction but were unforeseen during the design stage.
4. Use temporary erosion control measures when installation of permanent erosion control features cannot be accomplished.

The Engineer has the authority to:

- Limit the surface area of erodible earth material exposed by clearing and grubbing.
- Limit the surface area of erodible earth material exposed by excavation and borrow and fill operations.
- Limit the area of excavation, and embankment operations in progress to correspond with the Contractor's ability to keep the finish grading, mulching, seeding, and other permanent erosion control measures current.
- Direct the Contractor to provide immediate permanent or temporary erosion control to prevent contamination of adjacent streams or water courses, lakes, ponds, or other areas of water impoundment.

Such Work may include constructing items listed in the table in [Subsection 161.1.02.A, "Related References"](#) or other control devices or methods to control erosion.

E. Erodible Area

NOTE: Never allow the surface area of erodible earth material exposed at one time to exceed 17 acres (7 ha) except as approved by the State Construction Engineer.

The maximum of 17 acres (7 ha) of exposed erodible earth applies to the entire Project and to all of its combined operations as a whole, not to the exposed erodible earth of each individual operation.

Upon receipt of a written request from the contractor the State Construction Engineer, or his designee, will review; the request, any justifications and the Project conditions for waiver of the 17 acres (7 ha) limitation.

If the 17 acre limitation is increased by the State Construction Engineer, the WECS shall not be assigned to another project in that capacity and should remain on site each work day that the exposed acreage exceeds 17 acres.

After installing temporary erosion control devices, e.g., grassing, mulching, stabilizing an area, and having it approved by the Engineer, that area will be released from the 17 acres (7 ha) limit.

F. Perform Grading Operations

Perform the following grading operations:

1. Complete each roadway cut and embankment continuously, unless otherwise specified in the Contract or ordered by the Engineer.
2. Maintain the top of the earthwork in roadway sections throughout the construction stages to allow water to run off to the outer edges. .
3. Provide temporary slope drain facilities with inlets and velocity dissipaters (straw bales, silt fence, aprons, etc.) to carry the runoff water to the bottom of the slopes. Place drains at intervals to handle the accumulated water.
4. Continue temporary erosion control measures until permanent drainage facilities have been constructed, pavement placed, and the grass on planted slopes stabilized to deter erosion.

G. Perform Construction in Rivers and Streams

Perform construction in river and stream beds as follows:

1. Unless otherwise agreed to in writing by the Engineer, restrict construction operations in rivers, streams, and impoundments to:
 - Areas where channel changes or access for construction are shown on the Plans to construct temporary or permanent structures.
2. If channel changes or diversions are not shown on the Plans, the Contractor shall develop diversion plans prepared in accordance with the current GAR100002 NPDES Infrastructure Construction permit utilizing a design professional as defined within the permit. The Engineer will review prepared diversion plans for content only and accepts no responsibility for design errors or omissions. Amendments will be made part of the project plans by attachment. Include any associated costs in the price bid for the overall contract. Any contract time associated with the submittal or its review and subsequent response will not be considered for an extension of Contract time. All time associated with this subsection shall be considered incidental.
3. If additional access for construction or removal of work bridges, temporary roads/access or work platforms is necessary, and will require additional encroachment upon river or stream banks and bottoms, the contractor shall prepare a plan in accordance with the current GAR100002 NPDES Infrastructure Construction permit utilizing a design professional as defined within the permit. Plans should be submitted at least 12 weeks prior to the date the associated work is expected to begin. If necessary, the plan will be provided to the appropriate regulating authority, e.g. United States Army Corps of Engineers by the Department for consideration and approval. No work that impacts areas beyond what has been shown in the approved plans will be allowed to begin until written approval of the submitted plan has been provided by the Department. Approved plan amendments will be made part of the project plans by attachment. Include any associated costs in the price bid for the overall contract. Any contract time associated with the submittal or its review and subsequent response will not be considered for an extension of Contract time. All time associated with this subsection shall be considered incidental.
4. Clear rivers, streams, and impoundments of the following as soon as conditions permit:
 - Falsework
 - Piling that is to be removed
 - Debris
 - Other obstructions placed or caused by construction operations
5. Do not ford live streams with construction equipment.
6. Use temporary bridges or other structures that are adequate for a 25-year storm for stream crossings. Include costs in the price bid for the overall contract.
7. Do not operate mechanized equipment in live streams except to construct channel changes or temporary or permanent structures, and to remove temporary structures, unless otherwise approved in writing by the Engineer.

H. State Water Buffers and Environmental Restrictions

1. The WECS shall review the plans and contract documents for environmental restrictions, Environmentally Sensitive Areas (ESA), e.g. buffers, etc prior to performing land disturbing activities.
2. The WECS shall ensure all parties performing land disturbing activities within the project limits are aware of all environmental restrictions.
3. Buffer delineation shall be performed prior to clearing, or any other land disturbing activities. Site conditions may require temporary delineation measures are implemented prior to the installation of orange barrier/safety fencing. The means of temporary delineation shall have the Engineer's prior approval.
4. The WECS shall allow the Engineer to review the buffer delineation prior to performing any land disturbing activities, including but not limited to clearing, grubbing and thinning of vegetation. Any removal and relocation of buffer delineation based upon the Engineer's review will not be measured for separate payment.
5. The WECS shall advise the Engineer of any surface water(s) encountered that are not shown in the plans. The WECS shall prevent land disturbing activities from occurring within surface water buffers until the Engineer provides approval to proceed.

I. General Requirements

Projects that consist of asphalt resurfacing, shoulder reconstruction and/or shoulder widening; schedule and perform the construction of the project to comply with the following:

After temporary and permanent erosion control devices are installed and the area permanently stabilized (temporary or permanent) and approved by the Engineer, the area may be released from the 1 acre (0.4 ha) limit.

The maximum of 1 acre (0.4 ha) of erodible earth applies to the entire project and to all combined operations, including borrow and excess material operations that are within the right of way, not 1 acre (0.4 ha) of exposed erodible earth for each operation.

NOTE: Never allow the surface area of erodible earth material exposed at one time to exceed 1 acre (0.4 ha).

1. Do not allow the disturbed exposed erodible area to exceed 1 acres (0.4 ha). This 1 acre (0.4 ha) limit includes all disturbed areas relating to the construction of the project including but not limited to slope and shoulder construction.
2. At the end of each working day, permanently stabilize all of the area disturbed by slope and shoulder reconstruction to prevent any contamination of adjacent streams or other watercourses, lakes, ponds or other areas of water impoundment. For purposes of this Specification, the end of the working day is defined as when the construction operations cease. For example, 6:00 a.m. is the end of the working day on a project that allows work only between 9:00 p.m. and 6:00 a.m.)
3. Stabilize the cut and fill slopes and shoulder with permanent or temporary grassing and a Wood Fiber Blanket ([Section 713](#), Type II). Mulching is not allowed. Borrow pits, soil disposal sites and haul roads will not require daily applications of wood fiber blanket. The application rate for the Wood Fiber Blanket on shoulder reconstruction is the rate specified for Shoulders. For shoulder reconstruction, the ground preparation requirements of [Subsection 700.3.05.A.1](#) are waived. Preparation consists of scarifying the existing shoulders 4 to 6 in (100 to 150 mm) deep and leaving the area in a smooth uniform condition free from stones, lumps, roots or other material.

4. If a sudden rain event occurs that would not allow the Contractor to apply the Type II Wood Fiber Blanket per [Section 713](#), install Wood Fiber Blanket Type I per [Section 713](#) if directed by the Engineer. Wood Fiber Blanket Type I application is for emergency use only.

Install temporary grass or permanent grass according to seasonal limitations and Specifications. When temporary grass is used, use the overseeding method ([Subsection 700.3.05.E.4](#)) when planting permanent grass.

3. Remove and dispose of all material excavated for the trench widening operation at an approved soil disposal site by the end of each working day. When shoulder reconstruction is required, this material may be used to reconstruct the graded shoulder after all asphaltic concrete pavement has been placed.

4. Provide immediate permanent and/or temporary erosion control measures for borrow pits, soil disposal sites and haul roads to prevent any contamination of adjacent streams or other watercourses, lakes, ponds or other areas of water impoundment.

5. Place asphalt in the trench the same day as the excavation occurs. Place asphalt or concrete in driveways and side roads being re-graded the same day as the excavation occurs. Stabilize any disturbed or exposed soil that is not covered with asphalt with a Wood Fiber Blanket (and grass seed). Payment will be made for the Wood Fiber Blanket and grass seed only if the shoulder has been constructed to final dimensions and grade and no further grading will be required.

6. Do not allow the grading (height of cut or fill) to exceed the operating range of the grassing equipment.

7. When grading operations or other soil disturbing activities are suspended, regardless of the reason, promptly perform all necessary permanent stabilization and/or erosion control work.

8. Use temporary erosion control measures to:

To correct conditions that develop during construction but were unforeseen during the design stage.

To use as needed before installing permanent erosion control features.

To temporarily control erosion that develops during normal construction practices but are not associated with permanent control features on the Project.

9. When conditions warrant, such as unfavorable weather (rain event), the Engineer may require more frequent intervals for this work.

161.3.06 Quality Acceptance

Before Final Acceptance of the Work, clean drainage structures within the project limits, both existing and newly constructed, and ensure that they are functioning properly. Costs to accomplish this work are incidental and shall be included in the overall bid for the Contract.

161.3.07 Contractor Warranty and Maintenance

Maintain the erosion control features installed to:

- Contain erosion within the limits of the right-of-way
- Control storm water discharges from disturbed areas

Effectively install and maintain the erosion control features. Ensure these features contain the erosion and sediment within the limits of the rights of way and control the discharges of storm-water from disturbed areas to meet all local, state, and federal requirements on water quality.

If a construction Project has separate contractors, the Prime Contractor shall maintain the erosion control features at grading sites as acceptable to the Engineer until the Contract is accepted. If any erosion control devices are damaged by any contractor either by neglect, by construction methods, or any other reasons, including acts of nature, they shall be repaired within 24 hours by the Prime Contractor at no cost to the Department.

161.4 Measurement

Control of soil erosion and sedimentation is not measured separately for payment.

161.4.01 Limits

General Provisions 101 through 150.

161.5 Payment

When no pay item is shown in the Contract, the requirements of this Specification and the Erosion Control Plan shall be in full effect. The cost of complying with these requirements will not be paid for separately, but shall be included in the overall bid submitted with the exception of inspections performed by qualified personnel which will be included in Section 167.

When listed as a pay item in the Contract, payment will be made at the unit price bid for each particular item.

No payment will be made for erosion control outside the Right-of-Way or construction easements except as provided for by the Plans.

161.5.01 Enforcement and Adjustments

A. Failure to Provide a WECS

If a designated WECS is not maintained or if the Contractor does not comply with this Specification, cease activities except traffic control and erosion control work. Monies that are due or that may become due also may be withheld according to the Specifications

B. Failure to submit reports

A non-refundable deduction will be taken from the schedule below whenever the WECS fails to submit completed reports required by [Subsection 167.3.05.C](#) in accordance with the provisions of this specification.

C. Failure to Comply with Specifications

If the Contractor fails to comply with any of the requirements of this Specification, all activities shall cease immediately except traffic control and erosion control related work.

Monies that are currently due or that may become due shall be withheld according to the specifications. In addition, nonrefundable monies shall be deducted from the contract as shown in the Schedule of Deductions table below. These deductions are in addition to any actions taken in the above subsections. Deductions assessed for uncorrected deficiencies shall continue until all corrections are completed to the satisfaction of the Engineer.

D. Receipt of a Consent Order or Notice of Violation, etc

Regulatory enforcement actions will be resolved including at a minimum the following steps;

- The Department will perform an internal review of the alleged violations
- The Department will then meet with the Contractor to review and further determine responsibilities for the alleged violations
- The Department will then arrange to collectively meet with the regulatory agencies to negotiate resolutions and/or settlements.

The Department does not waive any rights of the Contractor to resolve such matters however, in the event that regulatory agency communication is addressed jointly to the Department and to the contractor, the Department reserves the right to coordinate all communications, e.g., written correspondence, and to schedule jointly attended meetings with Regulatory agencies such that timely and accurate responses are known to the Department.

Such Orders or Notices may result in the assessment of Deductions from the table below for each day the condition remains non-compliant following an agreed remedy.

Monetary penalties for which the contractor is obligated for as a result of regulatory enforcement may be withheld from future monies due the contractor.

Schedule of Deductions for Each Calendar Day of Erosion Control Deficiencies Initial Occurrence* Original Total Contract Amount		
From More Than	To and Including	Daily Charge
0	\$100,000	\$750
\$100,000	\$1,000,000	\$1125
\$1,000,000	\$5,000,000	\$2000
\$5,000,000	\$15,000,000	\$3000
\$15,000,000	-	\$5000

*Continued non-compliance with the requirements of this specification may result in the doubling of the above tabulated Daily Charge.

Upon written request from the Contractor, the Engineer may allow, limited activities to concurrently proceed once significant portions of the corrective work have been completed. This authorization may be similarly rescinded if in the opinion of the Engineer corrective work is not being diligently pursued.

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA**

SPECIAL PROVISION

Section 163—Miscellaneous Erosion Control Items

163.1 General Description

This work includes constructing and removing:

- Silt control gates
- Temporary erosion control slope drains shown on the Plans or as directed
- Sediment basins
- Baled straw sediment barrier and check dams
- Other temporary erosion control structures shown on the Plans or directed by the Engineer

This work also includes applying mulch (straw or hay, erosion control compost), and temporary grass.

163.1.01 Related References

A. Standard Specifications

[Section 109—Measurement and Payment](#)

[Section 161—Control of Soil Erosion and Sedimentation](#)

[Section 171—Temporary Silt Fence](#)

[Section 500—Concrete Structures](#)

[Section 603—Rip Rap](#)

[Section 700—Grassing](#)

[Section 715—Bituminous Treated Roving](#)

[Section 720 – Triangular Silt Barrier](#)

[Section 822—Emulsified Asphalt](#)

[Section 860—Lumber and Timber](#)

[Section 863—Preservative Treatment of Timber Products](#)

[Section 890—Seed and Sod](#)

[Section 893—Miscellaneous Planting Materials](#)

B. Referenced Documents

AASHTO M252

AASHTO M294

163.1.02 Submittals

Provide written documentation to the Engineer as to the average weight of the bales of mulch.

163.2 Materials

Provide materials shown on the Plans, such as pipe, spillways, wood baffles, and other accessories including an anti-seep collar, when necessary. The materials shall remain the Contractor's property after removal, unless otherwise shown on the Plans.

Materials may be new or used; however, the Engineer shall approve previously used materials before use.

Materials shall meet the requirements of the following Specifications:

Material	Section
Mulch	893.2.02
Temporary Silt Fence	171
Concrete Aprons and Footings shall be Class A	500
Rip Rap	603
Temporary Grass	700
Bituminous Treated Roving	715
Triangular Silt Barrier	720
Lumber and Timber	860.2.01
Preservative Treatment of Timber Products	863.1
Corrugated Polyethylene Temporary Slope Drain Pipe	AASHTO M252 or M294

163.2.01 Delivery, Storage, and Handling

General Provisions 101 through 150.

163.3 Construction Requirements

163.3.01 Personnel

General Provisions 101 through 150.

163.3.02 Equipment

General Provisions 101 through 150.

163.3.03 Preparation

General Provisions 101 through 150.

163.3.04 Fabrication

General Provisions 101 through 150.

163.3.05 Construction

A. Silt Control Gates

If silt control gates are required or are directed by the Engineer, follow these guidelines to construct them:

1. Clear and grade only that portion of the roadway within the affected drainage area where the drainage structure will be constructed.
2. Construct or install the drainage structure and backfill as required for stability.
3. Install the silt control gate at the inlet of the structure. Use the type indicated on the Plans.

4. Vary the height of the gate as required or as shown on the Plans.
5. Finish grading the roadway in the affected drainage area. Grass and mulch slopes and ditches that will not be paved. Construct the ditch paving required in the affected area.
6. Keep the gate in place until the work in the affected drainage area is complete and the erodible area is stabilized.
7. Remove the Type 1 silt gate assembly by sawing off the wood posts flush with the concrete apron. Leave the concrete apron between the gate and the structure inlet in place. The gate shall remain the property of the Contractor.

B. Temporary Slope Drains

If temporary slope drains are required, conduct the roadway grading operation according to [Section 161](#) and follow these guidelines:

1. Place temporary pipe slope drains with inlets and velocity dissipaters (straw bales, silt fence, or aprons) according to the Plans.
2. Securely anchor the inlet into the slope to provide a watertight connection to the earth berm. Ensure that all connections in the pipe are leak proof.
3. Place temporary slope drains at a spacing of 350 ft (105 m) maximum on a 0% to 2% grade and at a spacing of 200 ft (60m) maximum on steeper grades, or more frequently as directed by the Engineer. Keep the slope drains in place until the permanent grass has grown enough to control erosion.
4. Remove the slope drains and grass the disturbed area with permanent grass. However, the temporary slope drains may remain in place to help establish permanent grass if approved by the Engineer.

C. Sediment Basins

Construct sediment basins according to the Plans at the required location, or as modified by the Engineer.

1. Construct the unit complete as shown, including:
 - Grading
 - Drainage
 - Rip rap
 - Spillways
 - Anti-seep collar
 - Temporary mulching and grassing on internal and external slopes
 - Accessories to complete the basin
2. When the sediment basin is no longer needed, remove and dispose of the remaining sediment.
3. Remove the sediment basin. Grade to drain and restore the area to blend with the adjacent landscape.
4. Mulch and permanently grass the disturbed areas according to [Section 700](#).

D. Sediment Barrier (baled straw)

Construct sediment barrier (baled straw) according to the Plan details. Use rectangular, standard size baled straw in mechanically produced bales.

The following items may be substituted for sediment barrier (baled straw)

1. Type B Silt Fence.
2. Triangular Silt Barrier.

3. Synthetic Fiber: Use synthetic fiber bales of circular cross section at least 18 in (450 mm) in diameter. Use synthetic bales of 3 ft or 6 ft (0.9 m or 1.8 m) in length that are capable of being linked together to form a continuous roll of the desired total length. Use bales that are enclosed in a geotextile fabric and that contain a pre-made stake hole for anchoring.
4. Coir: Use coir fiber bales of circular cross section at least 16" (400mm) in diameter. Use coir bales of 10 ft, 15 ft, or 20 ft (3 m, 4.5 m, or 6 m) in length. Use coir baled with coir twine netting with 2 in X 2 in (50 mm X 50 mm) openings. Use coir bales with a dry density of at least 7 lb/ft³ (112 kg/m³). Anchor in place with 2 in X 4 in (50 mm X 100 mm) wooden wedges with a 6 in (150 mm) nail at the top. Place wedges no more than 36 in (900 mm) apart.
5. Excelsior: Use curled aspen excelsior fiber with barbed edges in circular bales of at least 18 in (450 mm) in diameter and nominally 10 ft (3 m) in length. Use excelsior baled with polyester netting with 1 in X 1 in (25 mm by 25 mm) triangular openings. Use excelsior bales with a dry density of at least 1.4 lb/ft³ (22 kg/m³). Anchor in place with 1 in (25 mm) diameter wooden stakes driven through the netting at intervals of no more than 2 ft (600 mm).
6. Compost Filter Sock: Use general use compost (see [Subsection 893.2.02.A.5.b](#)) in circular bales at least 18 in in diameter. Use compost baled with photo-degradable plastic mesh 3 mils thick with a maximum 0.25 in X 0.25 in (6 mm X 6 mm) openings. Anchor in place with 1 in (25 mm) diameter wooden stakes driven through the netting at intervals of no more than 2 ft (600 mm). The sock shall be dispersed on site when no longer required, as determined by the Engineer. Do not use Compost Filter Socks in areas where the use of fertilizer is restricted.
7. Compost Filter Berm: Use erosion control compost (see [Subsection 893.2.02](#)) to construct an uncompacted 1.5 ft to 2 ft (450 mm to 600 mm) high trapezoidal berm which is approximately 2 ft to 3 ft (600 mm to 1 m) wide at the top and minimum 4 ft (1.2 m) wide at the base. Do not use Compost Filter Berms in areas where the use of fertilizer is restricted.

The construction of the compost filter berm includes the following:

- a. Keeping the berm in a functional condition.
- b. Installing additional berm material when necessary.
- c. Removing the berm when no longer required, as determined by the Engineer. At the Engineer's discretion, berm material may be left to decompose naturally, or distributed over the adjacent area.

E. Other Temporary Structures

When special conditions occur during the design stage, the Plans may show other temporary structures for erosion control with required materials and construction methods.

F. Temporary Grass

Use a quick growing species of temporary grass such as rye grass, millet, or a cereal grass suitable to the area and season.

Use temporary grass in the following situations:

- When required by the Specifications or directed by the Engineer to control erosion where permanent grassing cannot be planted.
- To protect an area for longer than mulch is expected to last (60 calendar days).

Plant temporary grass as follows:

1. Use seeds that conform to [Subsection 890.2.01, "Seed."](#) Perform seeding according to [Section 700](#); except use the minimum ground preparation necessary to provide a seed bed if further grading is required.
2. Prepare areas that require no further grading according to [Subsection 700.3.05.A, "Ground Preparation."](#) Omit the lime unless the area will be planted with permanent grass without further grading. In this case, apply the lime according to [Section 700](#).

3. Apply mixed grade fertilizer at 400 lbs/acre (450 kg/ha). Omit the nitrogen. Mulch (with straw or hay) temporary grass according to [Section 700](#). (Erosion control compost Mulch will not be allowed with grassing.)
4. Before planting permanent grass, thoroughly plow and prepare areas where temporary grass has been planted according to [Subsection 700.3.05.A, "Ground Preparation"](#).
5. Apply Polyacrylamide (PAM) to all areas that receive temporary grassing.
6. Apply Pam (powder) before grassing or PAM (emulsion) to the hydroseeding operation.
7. Apply PAM according to manufacturer specifications.
8. Use only anionic PAM.

For projects that consist of shoulder reconstruction and/or shoulder widening refer to Section 161.3.05H for Wood Fiber Blanket requirements.

G. Mulch

When stage construction or other conditions prevent completing a roadway section continuously, apply mulch (straw or hay or erosion control compost) to control erosion. Mulch may be used without temporary grassing for 60 calendar days or less. Areas stabilized with only mulch (straw/hay) shall be planted with temporary grass after 60 calendar days.

Apply mulch as follows:

1. Mulch (Hay or Straw) - Without Grass Seed
 - a. Uniformly spread the mulch over the designated areas from 2 in to 4 in (50 mm to 100 mm) thick.
 - b. After spreading the mulch, walk in the mulch by using a tracked vehicle (preferred method), empty sheep foot roller, light disking, or other means that preserves the finished cross section of the prepared areas. The Engineer will approve of the method.
 - c. Place temporary mulch on slopes as steep as 2:1 by using a tracked vehicle to imbed the mulch into the slope.
 - d. When grassing operations begin, leave the mulch in place and plow the mulch into the soil during seed bed preparation. The mulch will become beneficial plant food for the newly planted grass.
2. Erosion control compost - Without Grass Seed
 - a. Uniformly spread the mulch (erosion control compost) over the designated areas 2 in (50 mm) thick.
 - b. When rolling is necessary, or directed by the Engineer, use a light corrugated drum roller.
 - c. When grassing operations begin, leave the mulch in place and plow the mulch into the soil during seed bed preparation. The mulch will become beneficial plant food for the newly planted grass.
 - d. Plant temporary grass on area stabilized with mulch (erosion control compost) after 60 calendar days.
 - e. Do not use Erosion Control Compost in areas where the use of fertilizer is restricted.

H. Miscellaneous Erosion Control Not Shown on the Plans

When conditions develop during construction that were unforeseen in the design stage, the Engineer may direct the Contractor to construct temporary devices such as but not limited to:

- Bulkheads
- Sump holes

- Half round pipe for use as ditch liners
- U-V resistant plastic sheets to cover critical cut slopes

The Engineer and the Contractor will determine the placement to ensure erosion control in the affected area.

I. Diversion Channels

When constructing a culvert or other drainage structure in a live stream that requires diverting a stream, construct a diversion channel.

J. Temporary Check Dams

Temporary check dams are constructed of the following materials;

- Stone plain rip rap according to [Section 603](#) or of sand bags as in [Section 603](#) without Portland cement. (Place plastic filter fabric on ditch section before placing rip rap.)
- Fabric (Type C silt fence)
- Hay Bales

Temporary check dams shall be constructed according to plan details and shall remain in place until the permanent ditch protection is in place or being installed and the removal is approved by the Engineer.

K. Construction Exits

Locate construction exits at any point where vehicles will be leaving the project onto a public roadway. Install construction exits at the locations shown in the plans and in accordance with plan details.

L. Retrofit

Add the retrofit device to the permanent outlet structure as shown on the Plan details.

When all land disturbing activities that would contribute sediment-laden runoff to the basin are complete, clean the basin of sediment and stabilize the basin area with vegetation.

When the basin is stabilized, remove the retrofit device from the permanent outlet structure of the detention pond.

M. Inlet Sediment Trap

Inlet sediment traps consist of a temporary device placed around a storm drain inlet to trap sediment. An excavated area adjacent to the sediment trap will provide additional sediment storage.

Inlet sediment traps may be constructed of Type C silt fence, plastic frame and filter, hay bales, baffle box, or other filtering materials approved by the Engineer.

Construct inlet sediment traps according to the appropriate specification for the material selected for the trap.

Place inlet sediment traps as shown on the Plans or as directed by the Engineer.

163.3.06 Quality Acceptance

General Provisions 101 through 150.

163.3.07 Contractor Warranty and Maintenance

General Provisions 101 through 150.

163.4 Measurement

A. Silt Control Gates

Silt control gates are measured for payment by the entire structure constructed at each location complete in place and accepted. Silt control gates constructed at the inlet of multiple lines of drainage structures are measured for payment as a single unit.

B. Temporary Slope Drains

Temporary slope drains are measured for payment by the linear foot (meter) of pipe placed. When required, the inlet spillway and outlet apron and/or other dissipation devices are incidental and not measured separately.

C. Sediment Basins

Sediment basins are measured for payment by the entire structure complete, including construction, maintenance, and removal. Measurement also includes:

- Earthwork
- Drainage
- Spillways
- Baffles
- Rip rap
- Final cleaning to remove the basin

Permanent and temporary grassing for sediment basins is measured separately for payment.

D. Diversion Channels

Diversion channels are not measured for payment. Costs for the entire structure complete, including materials, construction (including earthwork), and removal is included in the price bid for the drainage structure or for other Contract items.

E. Temporary Grass

Temporary grass is measured for payment by the acre (hectare). Lime, when required, is measured by the ton (megagram). Mulch and fertilizer are measured separately for payment.

F. Mulch

Mulch (straw or hay, or erosion control compost) is measured for payment by the ton (megagram).

G. Baled Straw Sediment Barrier, Baled Straw Check Dam and Fabric Check Dams

Baled straw sediment barrier, baled straw check dams, and fabric check dams are measured by the linear foot (meter). When the Contractor substitutes a product allowed in [Subsection 163.3.05.D](#) for baled straw sediment barrier or when the Engineer directs this substitution, the product will be measured by the linear foot (meter).

H. Rip Rap Check Dams

Rip Rap Check Dams are measured per each which will include all work necessary to construct the check dam including plastic filter fabric placed beneath the rip rap or sand bags.

I. Construction Exits

Construction exits are measured per each which will include all work necessary to construct the exit including the required geotextile fabric placed beneath the aggregate.

J. Retrofit

Retrofit will be measured for payment per each. The construction of the detention pond and permanent outlet structure will be measured separately under the appropriate items.

K. Inlet Sediment Trap

Inlet sediment traps, regardless of the material selected, are measured per each which includes all work necessary to construct the trap including any incidentals and providing the excavated area for sediment storage.

163.4.01 Limits

General Provisions 101 through 150.

163.5 Payment

A. Silt Control Gates

The specified silt control gates are paid for at the Contract Unit Price per each. Payment is full compensation for:

- Furnishing the material and labor
- Constructing the concrete apron as shown on the Plans
- Excavating and backfilling to place the apron
- Removing the gate

B. Temporary Slope Drains

Temporary slope drains are paid for by the linear foot (meter). Payment is full compensation for materials, construction, removal (if required), inlet spillways, velocity dissipaters, and outlet aprons.

When temporary drain inlets and pipe slope drains are removed, they remain the Contractor's property and may be reused or removed from the Project as the Contractor desires. Reused pipe or inlets are paid for the same as new pipe or inlets.

C. Sediment Basin

Sediment basins, measured according to [Subsection 163.4.C "Measurement,"](#) are paid for by the unit, per each, for the type specified on the Plans. Price and payment are full compensation for work and supervision to construct, and remove the sediment basin, including final clean-up.

D. Diversion Channel

Diversion channels are not paid for separately; they are included in the price bid for the drainage structure or for other Contract Items.

E. Temporary Grass

Temporary grass is paid for by the acre (hectare). Payment is full compensation for all equipment, labor, ground preparation, materials, wood fiber mulch, polyacrylamide, and other incidentals. Lime (when required) is paid for by the ton (megagram). Mulch and fertilizer are paid for separately.

F. Mulch

Mulch is paid for by the ton. Payment is full compensation for all materials, labor, maintenance, equipment and other incidentals.

The weight for payment of straw or hay mulch will be the product of the number of bales used and the average weight per bale as determined on certified scales provided by the contractor or state certified scales. Provide written documentation to the Engineer stating the average weight of the bales.

The weight of erosion control compost mulch will be determined by weighing each loaded vehicle on the required motor truck scale as the material is hauled to the roadway, or by using recorded weights if a digital recording device is used. The contractor may propose other methods of providing the weight of the mulch to Engineer for approval.

G. Baled Straw Sediment barrier, Baled Straw Check Dams and Fabric Check Dams (Type C Silt Fence)

Baled straw sediment barrier, baled straw check dams and fabric check dams (type C silt fence), complete in place and accepted are paid for at the Contract Unit Price bid per linear foot (meter). Payment is full compensation for constructing, and removing (when directed) the baled straw sediment barrier or either check dam.

When the Contractor substitutes any product allowed in [Subsection 163.3.05.D](#) for baled straw sediment barrier or when the Engineer directs this substitution, payment is made at the bid price per linear foot (meter) for baled straw sediment barrier.

H. Rip Rap Check Dams

Rip Rap Check Dams are paid for per each. Payment is full compensation for all materials, construction, and removal. Reused stone plain rip rap or sandbags are paid for on the same basis as new items. Filter fabric required under rip rap check dams is included in the price bid for each check dam.

I. Construction Exits

Construction exits are paid for per each. Payment is full compensation for all materials including the required geotextile, construction, and removal.

J. Retrofit

This item is paid for at the Contract Unit Price per each. Payment is full compensation for all work, supervision, materials (including the stone filter), labor and equipment necessary to construct and remove the retrofit device from an existing or proposed detention pond outlet structure.

K. Inlet Sediment Trap

Inlet sediment traps are paid for per each. Payment is full compensation for all materials, construction, and removal

The Items in this Section (except temporary grass and mulch) are made as partial payments as follows:

- When the item is installed and put into operation the Contractor will be paid 75 percent of the Contract price.
- When the Engineer instructs the Contractor that the Item is no longer required and is to remain in place or is removed, whichever applies, the remaining 25 percent will be paid.

Temporary devices may be left in place at the Engineer's discretion at no change in cost. Payment for temporary grass will be made based on the number of acres (hectares) grassed. Mulch will be based on the number of tons (megagrams) used.

Payment is made under:

Item No. 163	Construct and remove silt control gate, type__	Per each
Item No. 163	Construct and remove temporary pipe slope drains	Per linear foot (meter)
Item No. 163	Construct and remove temporary sediment barrier or baled straw check dam	Per linear foot (meter)
Item No. 163	Construct and remove sediment basin type__, Sta. No.____	Per each
Item No. 163	Construct and remove Fabric Check Dam - type C silt fence	Per linear foot (meter)
Item No. 163	Construct and remove Rip Rap Check Dams ,Stone Plain Rip Rap/Sand Bags	Per Each
Item No. 163	Construction exit	Per each
Item No. 163	Construct and remove retrofit, Sta. No.____	Per each
Item No. 163	Construct and remove inlet sediment trap	Per each
Item No. 163	Temporary grass	Per acre (hectare)
Item No. 163	Mulch	Per ton (megagram)

163.5.01 Adjustments

General Provisions 101 through 150.

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA**

SPECIAL PROVISION

**Section 165—Maintenance of Temporary Erosion and Sedimentation Control
Devices**

165.1 General Description

This work consists of providing maintenance on temporary erosion and sediment control devices, including but not limited to the following:

- Silt fence
- Sediment basins
- Silt control gates
- Check dams
- Silt retention barriers

It also consists of removing sediment that has accumulated at the temporary erosion and sediment control devices.

165.1.01 Definitions

General Provisions 101 through 150.

165.1.02 Related References

A. Standard Specifications

General Provisions 101 through 150.

B. Referenced Documents

General Provisions 101 through 150.

165.1.03 Submittals

General Provisions 101 through 150

165.2 Materials

General Provisions 101 through 150.

165.2.01 Delivery, Storage, and Handling

General Provisions 101 through 150.

165.3 Construction Requirements

165.3.01 Personnel

General Provisions 101 through 150.

165.3.02 Equipment

General Provisions 101 through 150.

165.3.03 Preparation

General Provisions 101 through 150.

165.3.04 Fabrication

General Provisions 101 through 150.

165.3.05 Construction

A. General

As a minimum, clean the sediment from all temporary erosion control devices (except sediment basins) installed on the project when one half the capacity, by height, depth or volume has been reached. Clean the sediment from all temporary sediment basins installed on a project when one third the capacity of the storage volume has been filled.

Handle sediment excavated from any erosion or sediment control device in one of the following ways:

- Remove sediment from the immediate area and immediately stabilize it to prevent the material from refilling any erosion or sediment control device.
- Place and mix it in the roadway embankment, or waste it in an area approved by the Engineer.
- Repair or replace at no cost to the Department, any erosion or sediment control devices that are not functioning properly or are damaged due to negligence or abuse.

B. Temporary Silt Fence

Maintenance of Temporary Silt Fence consists of furnishing all labor, tools, materials, equipment and necessary incidentals to remove and dispose of accumulated sediment down to the original ground line (0 % filled). Also included is the removal of sediment accumulations (“filtercake”) on the fabric by tapping the fabric on the downstream side.

C. Silt Control Gates

Maintenance of Temporary Silt Control Gates consists of all labor, tools, materials, equipment and necessary incidentals to remove and dispose of accumulated sediment down to the original ground line (0% filled). When applicable, this item will include the removal of sediment accumulations on the fabric by tapping the fabric on the downstream side.

D. Check Dams (all types)

Maintenance of Temporary Erosion Control Check Dams shall consist of all labor, tools, materials, equipment and necessary incidentals to remove and dispose of accumulated sediment down to the original ground line (0% filled). This item also includes the removal of any material deposited in sump holes. When applicable, this item will include the removal of sediment accumulations on the fabric by tapping the fabric on the downstream side, or from the baled straw by similar means.

E. Silt Retention Barrier

Maintenance of Temporary Silt Retention Barrier consists of all labor, tools, materials, equipment and necessary incidentals to remove and dispose of accumulated sediment down to the original ground line (0% filled).

F. Temporary Sediment Basins

Maintenance of Temporary Sediment Basins consists of all labor, tools, materials, equipment and necessary incidentals to remove and dispose of accumulated sediment down to the original bottom of the basin. This also includes removing accumulated sediment from the rock filter and restoring the rock filter to its original specified condition and any work necessary to restore all other components to the pre-maintenance conditions.

G. Sediment Barrier (baled straw)

Maintenance of sediment barrier (baled straw) consists of furnishing all labor, tools, materials, equipment and necessary incidentals to remove and dispose of accumulated sediment down to the original ground line (0 % filled). Also included is the removal of sediment accumulations on the bales by tapping.

H. Triangular Silt Barrier

Maintenance of Triangular Silt Barrier consists of all labor, tools, materials, equipment and necessary incidentals to remove and dispose of accumulated sediment down to the original ground line (0% filled).

I. Retrofit:

Maintenance of the retrofit device consists of all labor, tools, materials, equipment and necessary incidentals to remove and properly dispose of accumulated sediment in the permanent detention pond being utilized as a temporary sediment basin. This item also includes any maintenance that is required to ensure the retrofit device is maintained per Plan details and any maintenance of the stone filter to maintain its filtering ability, including cleaning and replacement.

J. Construction Exit:

Maintenance of the construction exit consists of all labor, tools, materials, equipment and incidentals, including additional stone and geotextile fabric as required to prevent the tracking or flow of soil onto public roadways. This includes, scarifying existing stone, cleaning existing stone, or placement of additional stone.

Cleaning of the construction exit by scraping and/or brooming only will not be measured for payment.

K. Inlet Sediment Trap

Maintenance of inlet sediment traps consists of all labor, tools, materials, equipment and necessary incidentals to remove and properly dispose of accumulated sediment in the trap and/or the excavated area adjacent to the trap. It also includes any maintenance that is required to remove sediment accumulations (“filtercake”) from the material selected to construct the inlet sediment trap.

165.3.06 Quality Acceptance

General Provisions 101 through 150.

165.3.07 Contractor Warranty and Maintenance

General Provisions 101 through 150.

165.4 Measurement

A. Temporary Silt Fence:

Maintenance of temporary silt fence, Type A, B, or C, is the actual linear feet (meter) of silt fence, measured in place, where sediment is removed.

B. Silt Control Gates:

Maintenance of temporary silt control gates, type I, II, III or IV, as specified on the Plans, is measured as a single unit.

C. Check Dams (All Types):

Maintenance of temporary erosion control check dams as specified on the Plans is the actual linear feet (meter) of baled straw, type c silt fence or rip rap, measured in place, where sediment is removed.

D. Silt Retention Barrier:

Maintenance of temporary silt retention barrier as specified on the Plans, is measured by the linear foot (meter) where sediment is removed.

E. Temporary Sediment Basins:

Maintenance of temporary sediment basins as specified on the Plans, is measured as a single unit.

F. Sediment Barrier (baled straw)

Maintenance of sediment barrier (baled straw), is the actual linear feet (meter) of baled straw measured in place, where sediment is removed.

F. Triangular Silt Barrier:

Maintenance of triangular silt barrier as specified on the plans, is measured by the linear foot (meter) where sediment is removed.

G. Retrofit:

Maintenance of retrofit device at the location specified on the Plans is measured per each.

H. Construction Exit:

Maintenance of construction exit at the location specified on the Plans, or as directed by the Engineer is measured per each.

I. Inlet Sediment Trap

Maintenance of inlet sediment trap at the location specified on the Plans, or as added by the Engineer is measured per each.

165.4.01 Limits

General Provisions 101 through 150.

165.5 Payment

A. Temporary Silt Fence:

Maintenance of temporary silt fence, Type A, B, or C, is paid for at the contract unit price bid per linear foot (meter).

B. Silt Control Gates:

Maintenance of temporary silt control gates, Type I, II, III, or IV as specified on the Plans is paid for at the contract unit price bid per each.

C. Check Dams (All Types):

Maintenance of Check Dams as specified on the Plans is paid for at the contract unit price bid per linear foot (meter).

D. Silt Retention Barrier:

Maintenance of temporary silt retention barrier as specified on the Plans is paid for at the contract unit price bid per linear foot (meter).

E. Temporary Sediment Basins:

Maintenance of temporary sediment basins as specified on the Plans is paid for at the contract unit price bid per each.

F. Sediment Barrier (baled straw):

Maintenance of sediment barrier (baled straw) as specified on the Plans is paid for at the contract unit price bid per linear foot (meter).

G. Triangular Silt Barrier:

Maintenance of triangular silt barrier as specified on the Plans is paid for at the contract unit price bid per linear foot (meter).

H. Retrofit:

Maintenance of the retrofit device at the location specified on the Plans is paid for at the contract unit price bid per each.

I. Construction Exit:

Maintenance of the construction exit at the location specified on the Plans or as added by the Engineer is paid for at the contract unit price per each.

J. Inlet Sediment Trap

Maintenance of the inlet sediment trap at the location specified on the Plans or at the location specified by the Engineer is paid for at the contract unit price per each.

Payment will be made under:

Item No. 165	Maintenance of temporary silt fence Type ____	per linear foot (meter)
Item No. 165	Maintenance of silt control gate Type ____	per each
Item No. 165	Maintenance of check dams - all types	per linear foot (meter)
Item No. 165	Maintenance of silt retention barrier	per foot (meter)
Item No. 165	Maintenance of temporary sediment basin, Sta. No. ____	per each
Item No. 165	Maintenance of sediment barrier - baled straw	per linear foot (meter)
Item No. 165	Maintenance of triangular silt barrier	per linear foot (meter)
Item No. 165	Maintenance of retrofit, Sta. No. ____	per each
Item No. 165	Maintenance of construction exit	per each
Item No. 165	Maintenance of inlet sediment trap	per each

165.5.01 Adjustments

General Provisions 101 through 150.

Date: August 26, 2002
First Use Date 2001 Specifications: November 1, 2002
Revised: January 16, 2003
Revised: August 1, 2003
Revised: February 1, 2004
Revised October 15, 2005
Revised July 15, 2008

DEPARTMENT OF TRANSPORTATION STATE OF GEORGIA

SPECIAL PROVISION

Section 167—Water Quality Monitoring

Add the following:

167.1 General Description

This Specification establishes the Contractor's responsibility to meet the requirements of the National Pollutant Discharge Elimination System (NPDES) Infrastructure Permit No. GAR 100002 as it pertains to Part IV. Erosion, Sedimentation and Pollution Control Plan.

167.1.01 Definitions

Certified Personnel— certified personnel are defined as persons who have successfully completed the appropriate certification course approved by the Georgia Soil and Water Conservation Commission. For Department projects the certified person must also have successfully completed the Department's WECS certification course.

167.1.02 Related References

A. Standard Specifications

[Section 161—Control of Soil Erosion and Sedimentation](#)

B. Referenced Documents

NPDES Infrastructure Permit No. GAR 100002, Part IV

GDOT WECS seminar.

Environmental Protection Divisions Rules and Regulations (Chapter 391-3-26)

Georgia Soil and Water Conservation Commission Certification Level IA course.

OCGA 12-7

167.1.03 Submittals

General Provisions 101 through 150

167.2 Materials

General Provisions 101 through 150.

167.2.01 Delivery, Storage, and Handling

General Provisions 101 through 150.

167.3 Construction Requirements

167.3.01 Personnel

Use certified personnel to perform all monitoring, sampling, inspections, and rainfall data collection.

Use the Contractor designated WECS or select a prequalified consultant from the Qualified Consultant List (QCL) to perform water quality monitoring.

Ensure that monitoring consultants' employees who perform monitoring, sampling, inspections, and rainfall data collection are GASWCC Certified.

167.3.02 Equipment

Provide equipment necessary to complete the Work or as directed.

167.3.03 Preparation

General Provisions 101 through 150.

167.3.04 Fabrication

General Provisions 101 through 150.

167.3.05 Construction

A. General

Perform inspections, rainfall data collection, testing of samples, and reporting the test results on the project according to the requirements in Part IV of the NPDES Infrastructure permit and this Specification.

Take samples manually or with the use of automatic samplers, according to the permit. Analyze all according to the permit, regardless of the method used to collect the samples.

If samples are analyzed in the field using portable turbidimeters, the monitoring results shall state that they are being used and a digital readout of NTUs is what is provided.

Submit bench sheets, work sheets, etc., when using portable turbidimeters. There are no exceptions to this requirement.

Perform required inspections and submit all reports required by this Specification within the time frames specified. Failure to perform the inspections within the time specified will result in the cessation of all construction activities with the exception of traffic control and erosion control. Failure to submit the required reports within the times specified will result in non-refundable deductions as specified in [Subsection 161.5.01.B](#).

B. Inspections

The Department will provide one copy of required inspection forms for use and duplication. Inspection forms may change during the contract to reflect regulatory agency needs or the need of the Department. Any costs associated with the change of inspection forms shall be considered incidental. Alternate formats of the provided forms maybe created, used and submitted by the Contractor provided the required content and/or data fields and verbatim certification statements from the Department's current forms are included.

The Engineer shall inspect the installation and condition of each erosion control device required by the erosion control plan within seven days after initial installation. This inspection is performed for each stage of construction when new devices are installed. The WECS shall ensure all installation deficiencies reported by the Engineer are corrected within two business days.

Ensure that the inspections of the areas listed below are conducted by certified personnel and at the frequencies listed. Document all inspections on the appropriate form provided by the Department.

1. Daily:

- a. Petroleum product storage, usage and handling areas
- b. All locations where vehicles enter/exit the site

Continue these inspections until all entry and exit sites are stabilized and fuel is not stored or transferred on the site. Utilize the Daily inspection form.

2. Weekly and after Rainfall Events:

Conduct inspections on these areas every seven calendar days and within twenty-four hours after the end of a rainfall event that is 0.5 in (13 mm) or greater:

- a. Disturbed areas not permanently stabilized
- b. Material storage areas

- c. Structural control measures, Best Management Practices (BMPs)
 - d. Water quality monitoring locations and equipment
- Continue these inspections until all BMPs have been removed. Utilize the EC-1 Form.
3. Monthly:
- Once per month, inspect all areas where final stabilization has been completed. Look for evidence of sediments or pollutants entering the drainage system and or receiving waters. Inspect all permanent erosion control devices that remain in place to verify the maintenance status and that the devices are functioning properly.
- Continue these inspections until the Notice of Termination is submitted. Utilize the Monthly inspection form.

C. Reports:

1. Inspection Reports:

Summarize the results of inspections noted above in writing on the appropriate Daily, Weekly, Monthly or EC-1 form provided by the Department. Include the following information:

- Date(s) of inspection
- Name of personnel performing inspection
- Status of devices
- Observations
- Action taken
- Signature of personnel performing the inspection
- Any incidents of non-compliance

The inspection form certification sheet shall be signed by the project WECS and the inspector performing inspections on behalf of the WECS (if not the same person).

Submit all inspection reports to the Engineer within twenty-four hours of the inspection.

The Engineer will review the submitted reports and inspect the project to determine their accuracy.

The Engineer will notify the certified personnel of any additional items that should be added to the inspection report.

Correct any items listed in the inspection report requiring routine maintenance within 72 (seventy-two) hours of notification.

Assume responsibility for all costs associated with additional sampling as specified in Part IV.D.6.d.3.(c) of the NPDES GAR 100002 permit if either of these conditions arise:

- BMPs shown in the Plans are not properly installed and maintained, or
- BMPs designed by the Contractor are not properly designed, installed and maintained.

2. Monitoring Reports

a. Report Requirements

Include in all reports, the following certification statement, signed by the WECS or consultant providing monitoring on the project:

“I certify under penalty of law that this document and all attachments were prepared under my direct supervision in accordance with a system designed to assure that certified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information is, to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.”

When a rainfall event requires a sample to be taken, submit a report of the monitoring results to the Engineer within seven working days of the date the sample was obtained. Include the following information:

- 1) Date of sampling
- 2) Rainfall amount on sample date (sample date only)
- 3) NTU of sample & analysis method
- 4) Location where sample was taken (station number, etc.)
- 5) Receiving water or outfall sample
- 6) Project number and county
- 7) Whether the sample was taken by automatic sampler or manually (grab sample)

b. Report Requirements with No Qualifying Rainfall Events

In the event that a qualifying rainfall event does not occur prior to the submittal of the NOT (Notice of Termination), submit a report that states “No qualifying rainfall event occurred and no samples were taken.”

c. Test Results

Provide monitoring test results to the Engineer within 48 hours of the samples being analyzed. This notification may be verbal or written. This notification does not replace the requirement to submit the formal monitoring summary to the Engineer within 7 working days of the samples being collected.

3. Rainfall Data Reports

Record the measurement of rainfall once each twenty-four hour period. Measure rainfall data at the active phase of construction on the site.

Project rain gauges and those used to trigger the automatic samplers are to be emptied after every rainfall event. This will prevent a cumulative effect and prevent automatic samplers from taking samples even though the rainfall event was not a qualifying event.

The daily rainfall data supplied by the WECS to the Engineer will be the official rainfall data for the project.

167.3.06 Quality Acceptance

General Provisions 101 through 150.

167.3.07 Contractor Warranty and Maintenance

General Provisions 101 through 150.

167.4 Measurement

Water Quality Inspections in accordance with the inspection and reports sub-sections will be measured for payment by the month up to the time the Contract Time expires. Required inspections and reports after Contract Time has expired will not be measured for payment.

Water Quality Monitoring and Sampling are measured per each. When the monitoring location is a receiving water, the upstream and downstream samples constitute one sample. When the monitoring location is an outfall, a single outfall sample constitutes one sample.

167.4.01 Limits

General Provisions 101 through 150. Submit the monitoring summary report to the Engineer within 7 working days

167.5 Payment

Payment for Water Quality Monitoring and Sampling will be made as follows:

Water Quality Monitoring and Sampling per each is full compensation for meeting the requirements of the monitoring sections of the NPDES permit and this Specification, obtaining samples, analyzing samples, any and all necessary incidentals, and providing results of turbidity tests to the Engineer, within the time frame required by the NPDES Infrastructure permit, and this Specification.

This item is based on the rainfall events that require sampling as described in Part IV.D.5 of the permit.

The Department will not pay for samples taken and analyzed for rainfall events that are not qualifying events as compared to the daily rainfall data supplied by the WECS.

Water Quality Inspections will be paid at the Contract Price per month. This is full compensation for performing the requirements of the inspection section of the NPDES permit and this Specification, any and all necessary incidentals, and providing results of inspections to the Engineer, within the time frame required by the NPDES Infrastructure permit, and this Specification.

Payment will be made under:

Item No. 167	Water quality inspections	Per month
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Water Quality Monitoring and Sampling will be paid per each.

Payment will be made under:

Item No. 167	Water quality monitoring and sampling	Per each
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167.5.01 Adjustments

General Provisions 101 through 150.

DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA
SPECIAL PROVISION

Section 170—Silt Retention Barrier

Delete Subsection 170.3.05 and substitute the following:

170.3.05 Construction

Install a silt retention barrier as follows: Barriers shall be either staked or floating depending upon current, tides, water depth, and other variables, or as shown in the plans and contract.

A. Floating Silt Retention Barrier

1. Confine dredged materials to ponding areas or settlement basins using standpipes or weirs.
2. Place the barrier approximately 25 ft (7.5 m) outside the affected construction area, and at a depth within 5 ft (1.5 m) of the bottom.
3. If the body of water has a significant current, place the barrier parallel to the water flow.
4. Vary the dimensions and methods to suit the conditions and to meet the requirements of other local and State water control agencies to ensure that silt dispersion is effectively controlled.
5. Provide a fabric that is weighted to prevent the bottom from floating.

B. Staked Silt Retention Barrier

1. Where a staked barrier is used to protect a stream or inundated area, ensure the fabric:
 - a. Extends to the bottom of the stream or inundated area and is weighted to prevent it from floating
 - b. Is not trenched in at the bottom
 - c. Extends 1 foot (300 mm) above normal water

2. Posts:
 - a. Options: 2 inch(50 mm) x 4 inch (100 mm) wood; or 2 ½ inch (62.5 mm min. diameter) wood; or steel at a minimum of 1.33 pounds per foot (1.980 kg/m)
 - b. space posts at a maximum spacing of 4 feet (1.2 m)
 - c. posts are minimum of 5 feet (1.5 m) in length
 - d. posts extend a minimum of 18 inches (450 mm) into the soil

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA**

SPECIAL PROVISION

Section 171—Silt Fence

Delete Section 171 and substitute the following:

171.1 General Description

This work includes furnishing, installing, and removing a water permeable filter fabric fence to remove suspended particles from drainage water.

171.1.01 Definitions

General Provisions 101 through 150.

171.1.02 Related References

A. Standard Specifications

[Section 163—Miscellaneous Erosion Control Items](#)

[Section 700—Grassing](#)

[Section 862—Wood Posts and Bracing](#)

[Section 881—Fabrics](#)

[Section 894—Fencing](#)

B. Referenced Documents

ASTM D 3786

ASTM D 4355

ASTM D 4632

ASTM D 4751

[GDT 87](#)

[QPL 36](#)

171.1.03 Submittals

General Provisions 101 through 150.

171.2 Materials

Materials shall meet the requirements of the following Specifications:

Material	Section
Filter Fabrics	881

Fencing	894
Wood Posts and Bracing	862

Conditions during Project construction will affect the quantity of the silt fence to be installed.

The Engineer may increase, decrease, or eliminate the quantity at his or her direction. Variations in quantity are not changes in details of construction or in the character of the work.

For Type A, B, and C fences, use fabric as specified in [Subsection 881.2.07, "Silt Fence Filter Fabric."](#)

171.2.01 Delivery, Storage, and Handling

During shipment and storage, wrap the fabric in a heavy-duty covering that will protect the cloth from sunlight, mud, dust, dirt, and debris. Do not expose the fabric to temperatures greater than 140 °F (60 °C).

When installed, the Engineer will reject the fabric if it has defects, rips, holes, flaws, deterioration, or damage incurred during manufacture, transportation, or storage.

171.3 Construction Requirements

171.3.01 Personnel

General Provisions 101 through 150.

171.3.02 Equipment

General Provisions 101 through 150.

171.3.03 Preparation

General Provisions 101 through 150.

171.3.04 Fabrication

General Provisions 101 through 150.

171.3.05 Construction

Install the silt fence according to this Specification, as shown on the Plans, or as directed by the Engineer as; perimeter, ditch check or similar protection.

A. Install Silt Fence

Install silt fence by either of the following methods:

1. Excavated Trench Method
 - a. Excavate a trench 4 to 6 in (100 to 150 mm) deep using equipment such as a trenching machine or motor grader. If equipment cannot be operated on the site, excavate the trench by hand.
2. Soil Slicing Method
 - a. Create a mechanical slice in the soil 8 to 12 in (200 to 300 mm) deep to receive the silt fence. Ensure that the width of the slice is not more than 3 in (75 mm). Mechanically insert the silt fence fabric into the slice in a simultaneous operation with the slicing that ensures consistent depth and placement.

Install the first post at the center of the low point (if applicable). Space the remaining posts a maximum of 6 ft (1.8 m) apart for Types A and B fence and 4 ft (1.2 m) apart for Type C fence.

Bury the posts at least 18 in (450 mm) into the ground. If this depth cannot be attained, secure the posts enough to prevent the fence from overturning from sediment loading.

Attach the filter fabric to the post using wire, cord, staples, nails, pockets, or other acceptable means.

- a. Staples and Nails (Wood Posts): Evenly space staples or nails with at least five per post for Type A fence and four per post for Type B fence.
- b. Pockets: If using pockets and they are not closed at the top, attach the fabric to a wood post using at least one additional staple or nail, or to a steel post using wire. Ensure that the additional attachment is within the top 6 in (150 mm) of the fabric.

Install the filter fabric so that 6 to 8 in (150 to 200 mm) of fabric is left at the bottom to be buried. Provide a minimum overlap of 18 in (450 mm) at all splice joints.

For Type C fence:

1. Woven Wire Supported
 - a. Steel Post: Use wire to attach the fabric to the top of the woven wire support fence at the midpoint between posts. Also, use wire to attach the fabric to the post.
2. Polypropylene Mesh Supported
 - a. Wood Post: Use at least six staples per post. Use two staples in a crisscross or parallel pattern to secure the top portion of the fence. Evenly space the remaining staples down the post.
 - b. Steel Post: Use wire to attach the fabric and polypropylene mesh to the post.

Install the fabric in the trench so that 4 to 6 in (100 to 150 mm) of fabric is against the side of the trench with 2 to 4 in (50 to 100 mm) of fabric across the bottom in the upstream direction.

Backfill and compact the trench to ensure that flow cannot pass under the barrier. When the slice method is used, compact the soil disturbed by the slice on the upstream side of the silt fence first, and then compact the downstream side.

When installing a silt fence across a waterway that produces significant runoff, place a settling basin in front of the fence to handle the sediment load, if required. Construct a suitable sump hole or storage area according to [Section 163](#).

B. Install silt fence ditch checks

Temporary Silt Fence Ditch Checks

Temporary silt fence ditch checks shall be constructed of the material type selected and shown on the approved erosion and sediment control plan. Item installation shall be constructed and placed according to approved Plan details. Temporary ditch checks shall remain in place until the permanent ditch protection is in place or being installed and the removal is approved by the Engineer.

C. Remove the Silt Fence

Keep all silt fence in place unless or until the Engineer directs it to be removed. A removed silt fence may be used at other locations if the Engineer approves of its condition.

After removing the silt fence, dress-the area to natural ground, grass-and mulch the area according to [Section 700](#).

The silt fence shall remain until the Project is accepted or until the fence is removed. Also, remove and dispose of the silt accumulations at the silt fence.

Remove and replace any deteriorated filter fabric that reduces the effectiveness of the silt fence.

Repair or replace any undermined silt fence at no additional cost to the Department.

171.3.06 Quality Acceptance

Approved silt fence is listed in [QPL 36](#). Approved fabrics must consistently exceed the minimum requirements of this Specification as verified by the Office of Materials and Research. The Office of Materials and Research will remove fabric that fails to meet the minimum requirements of this specification from the QPL until the products' acceptability has been reestablished to the Department's satisfaction.

At the time of installation, the Engineer will reject the fabric if it has defects, rips, holes, flaws, deterioration, or damage incurred during manufacture, transportation, or storage.

171.3.07 Contractor Warranty

The silt fence shall remain until the Project is accepted or until the fence is removed. Also, remove and dispose of the silt accumulations at the silt fence.

Remove and replace any deteriorated filter fabric that reduces the effectiveness of the silt fence.

Repair or replace any undermined silt fence at no additional cost to the Department.

171.4 Measurement

The quantity of silt fence, silt fence ditch checks to be paid for is the actual number of linear feet (meters) of silt fence, measured in place from end post to end post of each separate installation. The silt fence must be complete and accepted.

171.4.01 Limits

General Provisions 101 through 150.

171.5 Payment

Silt fence Type A, B, or C measured as defined in [Subsection 171.4, "Measurement,"](#) is paid for at the Contract Unit Price bid per linear foot (meter).

Payment is full compensation for the following:

- Furnishing materials
- Erecting the fence
- Dressing and grassing, when required
- Removing the fence, when required

Payment for this Item is made as follows:

Seventy-five percent of the Contract Price bid per linear foot (meter) is paid when each fence is complete in place.

Twenty-five percent is paid at removal or acceptance.

If the silt fence must be repaired or removed, as the result of neglect or damage, perform the work at no additional cost to the Department.

Payment will be made under:

Item No. 171	Silt fence, type__	Per linear foot (meter)
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171.5.01 Adjustments

General Provisions 101 through 150.

Office of Materials and Research

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA**

SUPPLEMENTAL SPECIFICATION

Section 207—Excavation and Backfill for Minor Structures

Delete Section 207.3.05.C and Substitute the following:

C. Backfill

Obtain backfill materials that meet the Specifications from sources approved by the Engineer.

1. Foundation Backfill Materials, Types I and II

Use the following materials as shown on the Plans or as directed by the Engineer:

- a. Use Type I material in dry structure trenches and Type II material in wet trenches.
- b. Use Type I material as a finishing course for Type II material when permitted by the Engineer.
- c. Backfill excavations beyond the specified limits with the same type of material required for the adjacent area; however, the Department will not measure excess backfill material for payment.
- d. Place Type I and Type II backfill material in layers of no more than 6 in (150 mm) loose.
- e. Compact each layer as follows:
 - 1) Type I Backfill Material: Compact to 95 percent of the theoretical dry density determined by [GDT 7](#).
 - 2) Type II Backfill Material: Compact to a satisfactory uniform density as directed by the Engineer.

2. Imperfect Trench Backfill Material, Type III

Place this material as loose uncompacted backfill over pipe structures as shown on the Plans where imperfect trench backfill is specified.

3. Normal Backfill

Ensure that normal backfill material meets the requirements of [Subsection 810.2.01](#), Class I or II. Class IIIC1 material may be used in Districts 6 and 7. Place and compact according to [Section 208](#) except as follows:

- a. Do not place rock more than 4 inches (100 mm) in diameter within 2 ft (600 mm) of any drainage structure.
- b. For backfill behind retaining walls, use a pervious material that meets the requirements of Case I or Case II as follows:
 - 1) Case I. Case I refers to backfills for retaining walls that support roadbeds and parking areas.
Ensure that the backfill conforms to [Section 208](#). Do not place rock more than 4 in (100 mm) in diameter within 2 ft (600 mm) of the retaining wall or finished surface.
 - 2) Case II. Case II refers to backfills for retaining walls that do not support roadbeds or parking areas.
Ensure that the backfill conforms to the requirements of Case I above, except compact the backfill to the density of the adjacent soil.

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA**

SPECIAL PROVISION

Section 208—Embankments

Delete Section 208 and substitute the following:

208.1 General Description

This work includes placing embankments, backfilling structures, and constructing earth berms and surcharges with suitable material excavated under [Section 204](#), [Section 205](#), [Section 206](#), and [Section 207](#).

Complete the work according to the lines, grades, and typical cross- sections shown on the Plans or established by the Engineer.

The work also includes preparing areas by backfilling stump holes and correcting surface irregularities where the embankment is to be constructed. This includes forming, compacting, and maintaining the embankment and placing and compacting approved material where unsuitable material has been removed.

Payment for this work is included in other appropriate Pay Items unless a specific Pay Item is set up in the Contract.

Apply all provisions of [Section 161](#) to the work in this Section.

Perform Shoulder Construction according to [Section 216](#).

208.1.01 Definitions

General Provisions 101 through 150.

208.1.02 Related References

A. Standard Specifications

[Section 161—Control of Soil Erosion and Sedimentation](#)

[Section 201—Clearing and Grubbing Right-of-Way](#)

[Section 204—Channel Excavation](#)

[Section 205—Roadway Excavation](#)

[Section 206—Borrow Excavation](#)

[Section 207—Excavation and Backfill for Minor Structures](#)

[Section 209—Subgrade Construction](#)

[Section 216—Unpaved Shoulders](#)

[Section 810—Roadway Materials](#)

[Section 811—Rock Embankment](#)

[Section 813—Pond Sand](#)

B. Referenced Documents

[GDT 7](#)

[GDT 20](#)

[GDT 21](#)

[GDT 24a](#)

[GDT 24b](#)

[GDT 59](#)

[GDT 67](#)

208.1.03 Submittals

General Provisions 101 through 150.

208.2 Materials

Embankment material classes are defined in [Section 810](#), [Section 811](#), and [Section 813](#). The material incorporated into the roadway will be subject to the following limitations:

A. Embankment Material

Use embankment material classified as Class I, II, III, V, or VI except as noted below:

1. Inundated Embankments

A Special Provision in the Proposal will contain required gradation and other characteristics of materials for constructing embankments through reservoirs.

2. Intermittently Inundated Embankments

Build intermittently inundated embankments using any material suitable for embankment.

3. Embankments at Structures

Use Class I or II embankment materials within 10 ft (3 m) of any bridge structure. Class IIIC1 material may be used in Districts 6 and 7. Class IIIC2 or IIIC3 material may only be used in Districts 6 and 7 if approved by the Office of Materials and Research, Geotechnical Engineering Bureau. Ensure that materials do not contain rock larger than 3 in (75 mm) for any dimensions.

B. Rock Embankment

Ensure that rock embankment placed as indicated on the Plans meets the requirements of [Section 811](#) unless specified otherwise in the Plans or in the Special Provisions.

C. In-Place Embankment

Construct in-place embankment with Class I, II, III, V, or VI material.

D. Backfill Material

Use Class I or Class II backfill material furnished and stockpiled as defined in [Subsection 810.2.01.A](#). Class IIIC1 material may be used in Districts 6 and 7. Class IIIC2 or IIIC3 material may only be used in Districts 6 and 7 if approved by the Office of Materials and Research, Geotechnical Engineering Bureau.

E. Pond Sand Embankment

Use pond sand that meets the requirements of [Section 813](#) as embankment material. Material is subject to the following approval limitations:

1. Pond sand will be approved on a stockpile basis only.
2. Pond Sand will not be approved for Type I or normal backfill materials or for backfill for mechanically stabilized walls.
3. Pond sand shall be encapsulated, when used as fill, with 2 ft (600 mm) of soil on the slopes and 3 ft (1 m) of soil on top.
4. Pond sand shall not be used on sidehill fills or fill widenings where any of the following conditions exist:
 - a. The proposed fill slope is steeper than 2:1.
 - b. The thickness of the proposed fill at its thinnest point, as measured perpendicularly from the new fill line to the existing ground slope/fill slope, is less than 7 ft (2.1 m), including 2 ft (600 mm) of soil cover.
 - c. The fill height exceeds 30 ft (9 m).

208.2.01 Delivery, Storage, and Handling

General Provisions 101 through 150.

208.3 Construction Requirements

208.3.01 Personnel

General Provisions 101 through 150.

208.3.02 Equipment

General Provisions 101 through 150.

208.3.03 Preparation

General Provisions 101 through 150.

208.3.04 Fabrication

General Provisions 101 through 150.

208.3.05 Construction

A. Benching Excavation for Embankment

This work includes excavating material forming benches in the existing ground beneath proposed embankments. Form benches to increase the bond between the existing ground and the proposed embankment.

This work is required where embankments are placed on hillsides or against existing embankments, which will be indicated on the Plans.

Construct the benches approximately 12 ft (3.7 m) wide unless otherwise shown on the Plans. Use material removed in the excavation in the embankments. The Department will make no additional payment for this work.

B. Embankments

Follow these requirements when constructing embankments:

1. Preparation for Embankments

Before starting embankment construction, clear and grub the embankment area according to [Section 201](#) and install Drainage Structures according to [Section 550](#).

a. Depressions and Undercut Areas

Fill depressions below the ground surface and undercut areas with suitable material. Remove unsuitable or unstable material and compact according to [Subsection 208.3.05.B.1.c](#) before beginning embankment construction.

b. Scarification and Other Preparation

Plow and scarify the entire area upon which the embankment is to be placed (except inundated areas) at least 6 in (150 mm) deep.

Before placing the embankment, recompact loosened soil to the approximate density of the underlying soil. Cut benches as specified in [Subsection 208.3.05.A](#).

c. Compaction Under Shallow Fills

When the depth of fill and surfacing is 3 ft (1 m) or less, compact the original ground compact at least 1 ft (300 mm) deep to at least 95 percent of the maximum laboratory dry density as determined from representative samples of the compacted material using, [GDT 7](#), [GDT 24a](#), [GDT 24b](#), or [GDT 67](#) whichever applies.

The in-place density of the compacted fill will be determined according to [GDT 20](#), [GDT 21](#), or [GDT 59](#), whichever applies.

d. Embankments Over Existing Roads, Parking Areas, and Floors

Thoroughly plow or scarify all portions of existing unpaved roads and flexible pavements. Destroy cleavage planes before placing the embankment.

- 1) Remove the old pavement with rigid surfaces if the new embankment is not more than 3 ft (1 m) high.
- 2) Break remaining rigid pavements that are within 10 ft (3 m) of the finished grade so that no section larger than 10 ft² (1 m²) remains intact.

2. Embankment Formation

Use the following requirements when constructing the embankment formation:

a. Layer Construction

Except as noted in [Subsection 208.3.05.B.2.d](#), construct the embankments in parallel layers. Deposit the material and spread in horizontal layers not more than 8 in (200 mm) thick, loose measurement, for the full width of the cross-section. Use motor graders, bulldozers, or other approved equipment to keep layers uniform. Compact the layers using a sheepsfoot roller. The Engineer may permit the use of vibratory rollers whenever the embankment soils consist of Class IA1, IA2, or IA3 materials.

b. Moisture Content

Compact each layer within the range of optimum moisture content to achieve the compaction specified below. Do not construct successive layers on previous layers that exhibit excessive pumping under construction equipment regardless of compaction.

Dry material if it contains too much moisture. Ensure the moisture content is sufficient for stability and compaction.

Add water if the material is too dry and uniformly mix it with the soil for stability and compaction. The Department will not measure water added to the material under this requirement for payment. It is considered incidental to the satisfactory completion of the work.

c. Degree of Compaction

Compact the embankment at bridge structures to at least 100 percent of the maximum laboratory dry density. Compact for the full depth of the embankment, beginning at the toe of the slope and extending 100 ft (30 m) from the end of the bridge.

Compact embankment other than at bridge structures to at least 95 percent of the maximum laboratory dry density to within 1 ft (300 mm) of the top of the embankment. Compact the top 1 ft (300 mm) of the embankment to at least 100 percent of the maximum laboratory dry density.

If grading and paving are let in separate contracts, the paving Contractor shall recompact the top 6 in (150 mm) to at least 100 percent of the maximum laboratory density.

The maximum laboratory dry density will be determined from representative samples of the compacted material using [GDT 7](#), [GDT 24a](#), [GDT 24b](#), or [GDT 67](#), whichever applies. The in-place density of the compacted fill will be determined according to [GDT 20](#), [GDT 21](#), or [GDT 59](#), whichever is applicable.

d. Special Conditions

Follow these special requirements:

- 1) Build layers as parallel as possible. In certain cases the Engineer may permit steeper slopes at ends of the embankments.
- 2) In swamp or inundated areas that will not support the equipment, build the lower part of the fill by dumping successive loads in layers no thicker than necessary to support the hauling equipment.
- 3) Build and compact the remainder of fills in layers as specified above.

e. Embankments at Structures

Use Class I or II material when constructing embankments over and around pipes, culverts, arches, and bridges according to [Subsection 810.2.01.A.1](#). Class IIIC1 material may be used in Districts 6 and 7.

- 1) Compact the material as specified in [Subsection 208.3.05.B.2.c](#).
- 2) Place the specified material on both sides of bridge structures for a distance of at least 10 ft (3 m).

<p>NOTE: Do not place rock larger than 4 in (100 mm) diameter within 2 ft (600 mm) of any drainage structure.</p>
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Before any traffic is allowed over any structure, provide a sufficient depth of material over and around the structure to protect it from damage or displacement.

f. Method of Handling Classes of Soils

Handle the different classes of soils using the following methods:

1) Class IIB3 and Better Soils

Distribute and compact these soils in 8 in (200 mm) uniform layers over the entire width of the embankment. Use these soils (when available in sufficient quantities) in the top 1 ft (300 mm) of the roadbed. Reserve these soils for this purpose when directed by the Engineer.

2) Class IIB4 Soils

Distribute and compact these soils in 8 in (200 mm) layers over the entire width of the embankment. If Class IIB3 or better soils are available in borrow pits, use these soils in the top 12 inch (300 mm) of subgrade. Class IIB4 soils may be used in the top 12 inch (300 mm) of subgrade if approved by the Office of Materials and Research, Geotechnical Engineering Bureau.

3) Class IIIC Soils

Class IIIC1 soils may be used in Districts 6 and 7 within the top 12 inch (300 mm) of subgrade if approved by the Office of Materials and Research, Geotechnical Engineering Bureau. Do not use Class IIIC2, IIIC3 or IIIC4 soils within the top 12 inch (300 mm) of subgrade unless a stabilizing agent approved by the Engineer is added, or if approved by the Office of Materials and Research, Geotechnical Engineering Bureau. Class IIIC4, chert clay soils in District 6 with less than 55 percent passing the No. 10 (2 mm) sieve may be used for subgrade.

4) Class IV Soils

Do not use these soils in embankments. Waste these soils or (when designated in the Plans or directed by the Engineer) stockpile them and use them for blanketing fill slopes.

5) Class V Soils

Place these soils in the same manner as Class IIB4 soils. Pulverize large particles to obtain the proper compaction.

6) Class VI Rock

Place rock in uniform layers not over 3 ft (1 m) thick and distribute it over the embankments to avoid pockets. Fill voids with finer material.

Do not place rock larger than 6 in (150 mm) in diameter within 3 ft (1 m) of the finished surface of the embankment.

Do not place rock larger than 6 in (150 mm) in diameter within 2 ft (600 mm) of the outer limits of proposed posts or utility poles.

Do not place rock at bridge end bents within 10 ft (3 m) of pile locations.

7) All Classes

Place mixtures of the above classes together with random material such as rock, gravel, sand, cinders, slag, and broken-up pavement so that coarse particles are dumped near the outer slopes and finer particles near the center of the roadway.

Produce a gradual transition from the center to the outside. If material is too large to place in 8 in (200 mm) layers, treat it as rock or break it down and place it in 8 in (200 mm) layers.

3. Embankment Consolidation at Bridge Ends

When consolidating embankments at bridge ends, use the following specifications:

- a. When a waiting period is required in the Plans or by Special Provision, place end fills at bridges in time for consolidation readings to indicate that both the fill and the natural ground have reached the desired degree of stability.
- b. Delay constructing bridge portions during the period of consolidation as shown on the Plans or as required by a Special Provision.

The Plans or the Special Provisions will indicate the estimated time required to reach consolidation.

The Engineer may extend or shorten this waiting period based on settlement readings taken on points placed in the fills. The longer or shorter waiting period will not constitute a valid claim for additional compensation.

Follow these specifications when extending a waiting period:

- 1) Extending an estimated waiting period may lead to increasing the Contract time. If the Contract is on a calendar day or completion date basis, the Department may increase the calendar days equal to the maximum number of calendar days involved in the extension.
- 2) When a time extension causes additional delay due to seasonal changes, the Engineer may recompute the time extension on an available day basis.
When the Contract is on an available day basis, the time increase will be equal to the greatest number of available days involved in the extension.
- 3) When time charges on separate Bridge Contracts are controlled by Special Provisions that set forth the availability of bridge sites, extending an estimated waiting period controls the availability of that bridge site only; time charges will be adjusted according to the Special Provision.

- c. Construct the embankment at bridge ends full-depth to the subgrade template (except for the stage construction providing a bench for the end bent) unless otherwise stated in the Plans and compact thoroughly before driving a piling at bridge ends.

The minimum acceptable length of completed full-depth embankment is equal to the maximum width of fill between slope stakes at the end of the bridge. The Department will measure the minimum length of full-depth embankment along the roadway centerline away from the end-of-bridge Station.

C. In-Place Embankment

Construct embankments designated on the Plans and in the Proposal as “In-Place Embankment” using either a hydraulic or conventional dry land construction method and using materials obtained from within the construction limits of the Right-of -Way or from borrow pits, whichever is appropriate.

Regardless of the method of construction, the Department will measure the entire embankment for payment as in-place embankment.

1. Construction

- Build embankments according to this Section when hydraulic or conventional dry land construction methods are used.
- Furnish equipment suitable for the method chosen to complete the work. Equipment is subject to the Engineer's approval.
- When using a hydraulic method is used, conform to these additional requirements:
 - a. Using baffles for construction is permitted as long as the embankment slopes are not steeper than indicated on the Plans.
 - b. Use of excess material placed outside the prescribed slopes to raise the fill is permitted.
 - c. Leave openings in the embankments at the bridge site as indicated on the Plans.
Dredge material that invades the openings or existing channels at no additional expense to the Department. Provide the same depth of channel at mean low water as existed before the construction of the embankment.
 - d. Do not excavate or dredge material within 500 ft (150 m) of the toe of the embankment or existing structures, unless otherwise shown on the Plans.
 - e. Place in-place embankment in areas previously excavated below the ground line in a uniform mass beginning at one end of the excavated area and continuing to the other end of the operation. Avoid forming of muck cores in the embankment.
 - f. Construct the embankment at the farthest points along the roadway from the bridge ends and progress to the end of the excavation area beyond the toe of the slope of endrolls at bridge ends.
 - g. Remove timber used for temporary bulkheads or baffles from the embankment.
 - h. Fill and thoroughly compact the holes.

2. Maintenance

- a. Maintain the embankment at grade until it has been completed and accepted. Assume responsibility for slides, washouts, settlement, subsidence, or mishaps to the work while under construction.
- b. Keep constructed embankment stable and replace displaced portions before Final Acceptance of the entire Contract.
- c. Remove and dispose of excess materials, including fill, detours, and erosion deposits placed outside the prescribed slopes in wetland areas.

3. Permits

Obtain (at no additional expense to the Department) necessary permits or licenses from the appropriate authorities to operate dredges and other floating equipment in waters under their jurisdiction, unless otherwise provided for in the Contract.

4. Erosion Control

In addition to the provisions of [Section 161](#), follow additional erosion, siltation, and pollution control measures specified in the Plans or Special Provisions.

D. Rock Embankment

This work includes furnishing materials either from the roadway excavation or other sources and hauling and the placing of rock embankment. Use materials that meet the requirements of [Subsection 208.2.B](#), as shown on the Plans or directed by the Engineer.

1. Place the rock in uniform layers not over 3 ft (1 m) thick. Distribute rock over the embankment to avoid pockets.

2. Fill voids with rock fines. Do not use rock larger than 6 in (150 mm) for any diameter within 3 ft (1 m) of the finished grade of the embankment, or within 2 ft (600 mm) of any structure.
3. Do not place rock at bridge end bents within 10 ft (3 m) of pile locations. Construct rock embankment and adjoining earth embankment concurrently. Ensure that neither is larger than 4 ft (1.2 m) higher than the other at any time.

E. Final Finishing

After constructing the entire embankment, shape the surface of the roadbed and the slopes to reasonably true grade and cross-sections as shown on the Plans or established by the Engineer.

Open ditches, channels, and drainage structures (both existing and those constructed or extended) to effectively drain the roadway. Maintain the embankment areas until Final Acceptance of the Project.

208.3.06 Quality Acceptance

General Provisions 101 through 150.

208.3.07 Contractor Warranty and Maintenance

General Provisions 101 through 150.

208.4 Measurement

The following section details measurement for payment for the work described in this Section:

- A. Except as provided herein, there will be no measurement for payment for the work covered by this Section.
- B. The Department will compute the quantity of in-place embankment or rock embankment using the average end area method, or other acceptable methods, when embankment is in place and accepted.

The quantity will be calculated as the neat volume, above the original ground surface, between the template line shown on the Plans or authorized changes by the Engineer, and the original ground surface.

The original ground surface is determined by conventional field, photogrammetric, or other methods. The Department will not deduct for the volume of culverts and manholes.

In-place embankment necessary for the construction of temporary detours will not be measured for payment and is considered incidental to the completion of the work unless specifically stated otherwise on the Plans.

Where work includes excavating of unstable materials below the ground line, the volume of embankment required for backfill below the ground line is calculated based on the neat line measurement for the cross-section shown on the Plans or established by the Engineer by the average end area method or other acceptable methods.

Where permitted by the Engineer or required by the Plans, material removed from the existing roadbed, special ditches, berm ditches, or dry land borrow pits and used in making embankment will be paid for as in-place embankment regardless of the method of excavation.

208.4.01 Limits

General Provisions 101 through 150.

208.5 Payment

Except as provided for herein, the Department will not make separate payment for placing embankments, backfilling structures, and constructing earth berms, including surcharges.

Payment will be included at the Contract Unit Price for the items covered by [Section 204](#), [Section 205](#), and [Section 206](#). Prices are full compensation for The Work covered by this Section.

The Unit Prices bid per cubic yard (meter) for in-place and rock embankments (when included as Contract bid Items) are full compensation for furnishing suitable material, hauling, placing, compacting, finishing, and dressing according to these Specifications or as directed by the Engineer.

Payment will be made under:

Item No. 208	In-place embankment	Per cubic yard (meter)
Item No. 208	Rock embankment	Per cubic yard (meter)

208.5.01 Adjustments

General Provisions 101 through 150.

Office of Materials and Research

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA**

SPECIAL PROVISION

Section 209—Subgrade Construction

Delete Subsection 209.3.05.C and substitute the following:

C. Select Materials Subgrade

Place select materials as follows:

1. Construct the subgrade with a uniform blanket of select material consisting of Class I or II soil or graded aggregate (according to Plan dimensions or as directed by the Engineer). Class IIIC1 soils may be used in Districts 6 and 7 within the top 12 inch (300 mm) of subgrade if approved by the Office of Materials and Research, Geotechnical Engineering Bureau. Do not use Class IIIC2, IIIC3 or IIIC4 soils within the top 12" (300mm) of subgrade unless a stabilizing agent approved by the Engineer is added, or if approved by the Office of Materials and Research, Geotechnical Engineering Bureau.
2. Use the select material reserved from the grading or borrow operations. If material is not available through this source, obtain it from other sources.
3. Finish and compact the material according to Subsection 209.3.05.A.

Office of Materials and Research

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA
SUPPLEMENTAL SPECIFICATION**

Section 211—Bridge Excavation and Backfill

Delete Subsection 211.3.05.D and substitute the following:

D. Backfill Construction

Follow these requirements when backfilling:

1. General

Backfilling is a part of the work of excavation, except as noted.

- a. Place the backfill in layers not exceeding 1 ft (300 mm) of loose material. Compact the layer before placing the next layer.

Backfill around all substructures except those located within the banks of a stream at normal water level.

- b. Do not jet backfills.

- c. Place backfill material to apply only balanced horizontal loads to a newly placed structure or portion of structure.

Do not backfill portions of structures that do not have backfill on all sides until the concrete has reached the required strength (as determined by the Engineer) to withstand the earth pressures.

2. Intermediate Bents and Piers

Compact backfill for intermediate bents and piers to the approximate density of the surrounding soil.

- a. Begin and complete backfilling around substructures not supported by piling the next workday after placing the lift, if possible. Backfill at least within three calendar days after placement.

- b. Backfill footings before beginning form work on the columns.

- c. Begin backfilling around pile-supported footings and columns after removing forms. Complete as soon as possible but within five calendar days after placing concrete.

3. End Bents and Abutments

Compact backfill for end bents and abutments (including their wingwalls) to the density shown on the Standard Plans or Special Plans.

- a. Begin and complete the work no later than five calendar days after placing concrete, unless other time limits are indicated on the Plans.

If other time limits are indicated, this work may be second stage construction or second stage backfill construction.

- b. Step slopes behind abutments, unless otherwise shown, and take precautions to prevent the backfill from wedging against the abutment.

- c. Provide drainage behind abutments and their wingwalls as shown on the Plans.

- d. Place backfill for abutment footings and portions of walls having fill on both sides of the wall according to Subsection 211.3.05.D.4.

4. Backfill Material

Backfill around intermediate bents and piers with material removed from the excavation, unless the material is unsatisfactory to the Engineer.

- a. Ensure that material for end bents and abutments meets the requirements shown on the Standard Plans or Special Plans.

Section 211—Bridge Excavation and Backfill

When suitable material is not available within the immediate vicinity of the bridge within the right-of-way, locate a source acceptable to the Engineer and haul the material to the site.

- b. Obtain and place backfill material necessary for end bent and abutment construction— including special backfill material used in constructing mechanically stabilized earth wall abutments.
- c. Ensure that material located and hauled to the bridge site meets the requirements of Class I, Class II, or as shown in [Subsection 810.2.01.A.1](#), unless otherwise noted. Class IIIC1 material may be used in Districts 6 and 7.
- d. Ensure that porous backfill (when specified) consists of coarse aggregate size No. 57 as specified in [Subsection 800.2.01](#), or crushed stone drainage material as specified in [Subsection 806.2.02.A](#).

Office of Materials and Research

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DEPARTMENT OF TRANSPORTATION

STATE OF GEORGIA

SPECIAL PROVISION

Section 400—Hot Mix Asphaltic Concrete Construction

Delete Section 400 and substitute the following:

400.1 General Description

This work includes constructing one or more courses of bituminous plant mixture on the prepared foundation or existing roadway surface. The mixture shall conform with lines, grades, thicknesses, and typical cross sections shown on the Plans or established by the Engineer.

This section includes the requirements for all bituminous plant mixtures regardless of the gradation of the aggregates, type and amount of bituminous material, or pavement use.

Acceptance of work is on a lot-to-lot basis according to the requirements of this Section and [Section 106](#).

400.1.01 Definitions

Segregated Mixture: Mixture lacking homogeneity in HMA constituents of such a magnitude that there is a reasonable expectation of accelerated pavement distress or performance problems. May be quantified by measurable changes in temperature, gradation, asphalt content, air voids, or surface texture.

New Construction: A roadway section more than 0.5 mile (800 m) long that is not longitudinally adjacent to the existing roadway. If more than one lane is added, and if any of the lanes are longitudinally adjacent to the existing lane, the lanes shall be tested under the criteria for a resurfacing project.

Trench Widening: Widening no more than 4 ft. (1.2 m) in width.

Comparison sample: Opposite quarter of material sampled by the Contractor.

Quality assurance sample: Independent sample taken by the Department.

Referee sample: A sample of the material remaining after quartering which is used for evaluation if a comparison of Contractor and Departmental test results is outside allowable tolerances.

400.1.02 Related References

A. Standard Specifications

[Section 106—Control of Materials](#)

[Section 109—Measurement and Payment](#)

[Section 152—Field Laboratory Building](#)

[Section 413—Bituminous Tack Coat](#)

[Section 424—Bituminous Surface Treatment](#)

Section 400—Hot Mix Asphaltic Concrete Construction

[Section 802—Coarse Aggregate for Asphaltic Concrete](#)

[Section 828—Hot Mix Asphaltic Concrete Mixtures](#)

B. Referenced Documents

AASHTO T 209

AASHTO T 202

AASHTO T 49

Laboratory Standard Operating Procedure (SOP) 27, “Quality Assurance for Hot Mix Asphaltic Concrete Plants in Georgia”

Department of Transportation Standard Operating Procedure (SOP) 15

[GDT 38](#)

[GDT 73](#)

[GDT 78](#)

[GDT 83](#)

[GDT 93](#)

[GDT 119](#)

[GDT 125](#)

[GDT 134](#)

[GSP 15](#)

[GSP 21](#)

[QPL 1](#)

[QPL 2](#)

[QPL 7](#)

[QPL 26](#)

[QPL 30](#)

[QPL 39](#)

[QPL 41](#)

[QPL 45](#)

[QPL 65](#)

[QPL 67](#)

[QPL 70](#)

[QPL 77](#)

400.1.03 Submittals

A. Invoices

When the Department requests, furnish formal written invoices from a supplier for all materials used in production of HMA. Show the following on the Bill of Lading:

- Date shipped
- Quantity in tons (megagrams)
- Included with or without additives (for asphalt cement)

Purchase asphaltic cement from a supplier who will provide copies of Bill of Lading upon the Department’s request.

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B. Paving Plan

Before starting asphaltic concrete construction, submit a written paving plan to the Engineer for approval. Include the following on the paving plan:

- Proposed starting date
- Location of plant(s)
- Rate of production
- Average haul distance(s)
- Number of haul trucks
- Paver speed feet (meter)/minute for each placement operation
- Mat width for each placement operation
- Number and type of rollers for each placement operation
- Sketch of the typical section showing the paving sequence for each placement operation
- Electronic controls used for each placement operation
- Temporary pavement marking plan

If staged construction is designated in the Plans or contract, provide a paving plan for each construction stage.

If segregation is detected, submit a written plan of measures and actions to prevent segregation. Work will not continue until the plan is submitted to and approved by the Department.

C. Job Mix Formula

After the Contract has been awarded, submit to the Engineer a written job mix formula proposed for each mixture type to be used based on an approved mix design. Furnish the following information for each mix:

- Specific project for which the mixture will be used
- Source and description of the materials to be used
- Mixture I.D. Number
- Proportions of the raw materials to be combined in the paving mixture
- Single percentage of the combined mineral aggregates passing each specified sieve
- Single percentage of asphalt by weight of the total mix to be incorporated in the completed mixture
- Single temperature at which to discharge the mixture from the plant
- Theoretical specific gravity of the mixture at the designated asphalt content
- Name of the person or agency responsible for quality control of the mixture during production

Do the following to have the formulas approved and to ensure their quality:

1. Submit proposed job mix formulas for review at least two weeks before beginning the mixing operations.
2. Do not start hot mix asphaltic concrete work until the Engineer has approved a job mix formula for the mixture to be used. No mixture will be accepted until the Engineer has given approval.
3. Provide mix designs for all Superpave and 4.75 mm mixes to be used. The Department will provide mix design results for other mixes to be used.
4. After a job mix formula has been approved, assume responsibility for the quality control of the mixtures supplied to the Department according to [Subsection 106.01, "Source of Supply and Quantity of Materials."](#)

D. Quality Control Program

Submit a Quality Control Plan to the Office of Materials and Research for approval. The Quality Control Program will be included as part of the certification in the annual plant inspection report.

400.2 Materials

Ensure that materials comply with the specifications listed in Table 1.

Table 1—Materials Specifications

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Material	Subsection
Asphalt Cement, Grade Specified	820.2
Coarse Aggregates for Asphaltic Concrete	802.2.02
Fine Aggregates for Asphaltic Concrete	802.2.01
Mineral Filler	883.1
Heat Stable Anti-Stripping Additive	831.2.04
Hydrated Lime	882.2.03
Silicone Fluid	831.2.05
Bituminous Tack Coat: PG 58-22, PG 64-22, PG 67-22	820.2
Hot Mix Asphaltic Concrete Mixtures	828
Fiber Stabilizing Additives	819

When required, provide Uintaite material, hereafter referred to by the common trade name Gilsonite, as a reinforcing agent for bituminous mixtures. Supply a manufacturer’s certification that the Gilsonite is a granular solid which meets the following requirements:

Softening Point (AASHTO: T-53)	300-350 °F (150-175 °C)
Specific Gravity, 77 °F (25 °C) (AASHTO: T-228)	1.04 ± 0.02
Flash Point, COC (AASHTO: T-48)	550 °F (290 °C) Min.
Ash Content (AASHTO: T-111)	1.0% Max.
Penetration, 77 °F (25 °C), 100 gm., 5 sec. (AASHTO: T-49)	0

400.2.01 Delivery, Storage, and Handling

Storage of material is allowed in a properly sealed and insulated system for up to 24 hours except that Stone Matrix Asphalt (SMA), Open-Graded Friction Course (OGFC), or Porous European Mix (PEM) mixtures shall not be stored more than 12 hours. Mixtures other than SMA, OGFC, or PEM may be stored up to 72 hours in a sealed and insulated system, equipped with an auxiliary inert gas system, with the Engineer’s approval. Segregation, lumpiness, drain-down, or stiffness of stored mixture is cause for rejection of the mixture. The Engineer will not approve using a storage or surge bin if the mixture segregates, loses excessive heat, or oxidizes during storage.

The Engineer may obtain mixture samples or recover asphalt cement according to [GDT 119](#). AASHTO T 202 and T 49 will be used to perform viscosity and penetration tests to determine how much asphalt hardening has occurred.

A. Vehicles for Transporting and Delivering Mixtures

Ensure that trucks used for hauling bituminous mixtures have tight, clean, smooth beds.

Follow these guidelines when preparing vehicles to transport bituminous mixtures:

1. Use an approved releasing agent from [QPL 39](#) in the transporting vehicle beds, if necessary, to prevent the mixture from sticking to the bed. Ensure that the releasing agent is not detrimental to the mixture. When applying the agent, drain the excess agent from the bed before loading. Remove from the project any transporting vehicles determined to contain unapproved releasing agents.
2. Protect the mixture with a waterproof cover large enough to extend over the sides and ends of the bed. Securely fasten the waterproof cover before the vehicle begins moving.
3. Insulate the front end and sides of each bed with an insulating material with the following specifications:
 - Consists of builders insulating board or equivalent
 - Has a minimum “R” value of 4.0
 - Can withstand approximately 400 °F (200 °C) temperatures

Install the insulating material so it is protected from loss and contamination. A “Heat Dump Body” may be used in lieu of insulation of the bed. “Heat Dump Body” refers to any approved transport vehicle that is capable of diverting

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engine exhaust and transmitting heat evenly throughout the dump body to keep asphalt at required temperature. Mark the “Heat Dump Body” clearly with “OPEN” and “CLOSE” position at the exhaust diverter. Install a padlock and lock it in the “OPEN” position when the “Heat Dump Body” is used to transport bituminous mixtures.

4. Mark each transporting vehicle with a clearly visible identification number.
5. Create a hole in each side of the bed so that the temperature of the loaded mixture can be checked. The placement of these holes shall be located to assure that the thermometer is being placed in the hot mix asphaltic concrete.

Ensure that the mixture is delivered to the roadway at a temperature within ± 20 °F (± 11 °C) of the temperature on the job mix formula.

If the Engineer determines that a truck may be hazardous to the Project or adversely affect the quality of the work, remove the truck from the project.

B. Containers for Transporting, Conveying, and Storing Bituminous Material

To transport, convey, and store bituminous material, use containers free of foreign material and equipped with sample valves. Bituminous material will not be accepted from conveying vehicles if material has leaked or spilled from the containers.

400.3 Construction Requirements

400.3.01 Personnel

General Provisions 101 through 150.

400.3.02 Equipment

Hot mix asphaltic concrete plants that produce mix for Department use are governed by Quality Assurance for Hot Mix Asphaltic Concrete Plants in Georgia, Laboratory Standard Operating Procedure No. 27.

The Engineer will approve the equipment used to transport and construct hot mix asphaltic concrete. Ensure that the equipment is in satisfactory mechanical condition and can function properly during production and placement operations. Place the following equipment at the plant or project site:

A. Field Laboratory

Provide a field laboratory according to [Section 152](#).

B. Plant Equipment

1. Scales

Provide scales as follows:

- a. Furnish (at the Contractor’s expense) scales to weigh bituminous plant mixtures, regardless of the measurement method for payment.
- b. Ensure that the weight measuring devices that provide documentation comply with [Subsection 109.01, “Measurement and Quantities.”](#)
- c. When not using platform scales, provide weight devices that record the mixture net weights delivered to the truck. A net weight system will include, but is not limited to:
 - Hopper or batcher-type weight systems that deliver asphaltic mixture directly to the truck
 - Fully automatic batching equipment with a digital recording device
- d. Use a net weight printing system only with automatic batching and mixing systems approved by the Engineer.
- e. Ensure that the net weight scale mechanism or device manufacturer, installation, performance, and operation meets the requirements in [Subsection 109.01, “Measurement and Quantities”](#)
- f. Provide information on the Project tickets according to Department of Transportation SOP-15.

2. Time-Locking Devices

Furnish batch type asphalt plants with automatic time-locking devices that control the mixing time automatically. Construct these devices so that the operator cannot shorten or eliminate any portion of the mixing cycle.

3. Surge- and Storage-Systems

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Provide surge and storage bins as follows:

- a. Ensure that bins for mixture storage are insulated and have a working seal, top and bottom, to prevent outside air infiltration and to maintain an inert atmosphere during storage. Bins not intended as storage bins may be used as surge bins to hold hot mixtures for part of the working day. However, empty these surge bins completely at the end of the working day.
- b. Ensure that surge and storage bins can retain a predetermined minimum level of mixture in the bin when the trucks are loaded.
- c. Ensure that surge and storage systems do not contribute to mix segregation, lumpiness, drain-down, or stiffness.

4. Controls for Dust Collector Fines

Control dust collection as follows:

- a. When collecting airborne aggregate particles and returning them to the mixture, have the return system meter all or part of the collected dust uniformly into the aggregate mixture and waste the excess. The collected dust percentage returned to the mixture is subject to the Engineer's approval.
- b. When the collected dust is returned directly to the hot aggregate flow, interlock the dust feeder with the hot aggregate flow and meter the flow to maintain a flow that is constant, proportioned, and uniform.

5. Mineral Filler Supply System

When mineral filler is required as a mixture ingredient:

- a. Use a separate bin and feed system to store and proportion the required quantity into the mixture with uniform distribution.
- b. Control the feeder system with a proportioning device that meets these specifications:
 - Is accurate to within ± 10 percent of the filler required
 - Has a convenient and accurate means of calibration
 - Interlocks with the aggregate feed or weigh system to maintain the correct proportions for all rates of production and batch sizes
- c. Provide flow indicators or sensing devices for the mineral filler system and interlock them with the plant controls to interrupt the mixture production if mineral filler introduction fails to meet the required target value after no longer than 60 seconds.
- d. Add mineral filler to the mixture as follows, according to the plant type:
 - Batch Type Asphalt Plant. Add mineral filler to the mixture in the weigh hopper.
 - Continuous Plant Using Pugmill Mixers. Feed the mineral filler into the hot aggregate before it is introduced into the mixer so that dry mixing is accomplished before the bituminous material is added.
 - Continuous Plants Using the Drier-Drum Mixers. Add the mineral filler so that dry mixing is accomplished before the bituminous material is added and ensure that the filler does not become entrained into the air stream of the drier.

6. Hydrated Lime Treatment System

When hydrated lime is required as a mixture ingredient:

- a. Use a separate bin and feed system to store and proportion the required quantity into the mixture.
- b. Ensure that the aggregate is uniformly coated with hydrated lime aggregate before adding the bituminous material to the mixture. Add the hydrated lime so that it will not become entrained in the exhaust system of the drier or plant.
- c. Control the feeder system with a proportioning device that meets these specifications:
 - Is accurate to within ± 10 percent of the amount required
 - Has a convenient and accurate means of calibration
 - Interlocks with the aggregate feed or weigh system to maintain the correct proportions for all rates of production and batch sizes and to ensure that mixture produced is properly treated with lime
- d. Provide flow indicators or sensing devices for the hydrated lime system and interlock them with the plant controls to interrupt mixture production if hydrated lime introduction fails to meet the required target value after no longer than 60 seconds.

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7. Net Weight Weighing Mechanisms

Certify the accuracy of the net weight weighing mechanisms by an approved registered scale serviceperson at least once every 6 months. Check the accuracy of net weight weighing mechanisms at the beginning of Project production and thereafter as directed by the Engineer. Check mechanism accuracy as follows:

- a. Weigh a load on a set of certified commercial truck scales. Ensure that the difference between the printed total net weight and that obtained from the commercial scales is no greater than 4 lbs/1,000 lbs (4 kg/Mg) of load.

Check the accuracy of the bitumen scales as follows:

- Use standard test weights.
 - If the checks indicate that printed weights are out of tolerance, have a registered scale serviceperson check the batch scales and certify the accuracy of the printer.
 - While the printer system is out of tolerance and before its adjustment, continue production only if using a set of certified truck scales to determine the truck weights.
- b. Have plants that use batch scales maintain ten 50 lb (25 kg) standard test weights at the plant site to check batching scale accuracy.

Ensure that plant scales that are used only to proportion mixture ingredients, not to determine pay quantities, are within two percent throughout the range.

8. Fiber Supply System

When stabilizing fiber is required as a mixture ingredient:

- a. Use a separate feed system to store and proportion by weight the required quantity into the mixture with uniform distribution.
- b. Control the feeder system with a proportioning device that meets these Specifications:
 - Is accurate to within ± 10 percent of the amount required. Automatically adjusts the feed rate to maintain the material within this tolerance at all times
 - Has a convenient and accurate means of calibration
 - Provide in-process monitoring, consisting of either a digital display of output or a printout of feed rate, in pounds (kg) per minute, to verify feed rate
 - Interlocks with the aggregate feed or weigh system to maintain the correct proportions for all rates of production and batch sizes
- c. Provide flow indicators or sensing devices for the fiber system and interlock them with the plant controls to interrupt the mixture production if fiber introduction fails or if the output rate is not within the tolerances given above.
- d. Introduce the fiber as follows:
 - When a batch type plant is used, add the fiber to the aggregate in the weigh hopper. Increase the batch dry mixing time by 8 to 12 seconds from the time the aggregate is completely emptied into the mixer to ensure the fibers are uniformly distributed prior to the injection of asphalt cement into the mixer.
 - When a continuous or drier-drum type plant is used, add the fiber to the aggregate and uniformly disperse prior to the injection of asphalt cement. Ensure the fibers will not become entrained in the exhaust system of the drier or plant.

C. Equipment at Project Site

1. Cleaning Equipment

Provide sufficient hand tools and power equipment to clean the roadway surface before placing the bituminous tack coat. Use power equipment that complies with [Subsection 424.3.02.F, "Power Broom and Power Blower."](#)

2. Pressure Distributor

To apply the bituminous tack coat, use a pressure distributor that complies with [Subsection 424.3.02.B, "Pressure Distributor."](#)

3. Bituminous Pavers

To place hot mix asphaltic concrete, use bituminous pavers that can spread and finish courses that are:

- As wide and deep as indicated on the Plans

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- True to line, grade, and cross section
 - Smooth
 - Uniform in density and texture
- a. Continuous Line and Grade Reference Control. Furnish, place, and maintain the supports, wires, devices, and materials required to provide continuous line and grade reference control to the automatic paver control system.
- b. Automatic Screed Control System. Equip the bituminous pavers with an automatic screed control system actuated from sensor-directed mechanisms or devices that will maintain the paver screed at a pre-determined transverse slope and elevation to obtain the required surface.
- c. Transverse Slope Controller. Use a transverse slope controller capable of maintaining the screed at the desired slope within ± 0.1 percent. Do not use continuous paving set-ups that result in unbalanced screed widths or off-center breaks in the main screed cross section unless approved by the Engineer.
- d. Screed Control. Equip the paver to permit the following four modes of screed control. The method used shall be approved by the Engineer.
- Automatic grade sensing and slope control
 - Automatic dual grade sensing
 - Combination automatic and manual control
 - Total manual control

Ensure that the controls are referenced with a taut string or wire set to grade, or with a ski-type device or mobile reference at least 30 ft (9 m) long when using a conventional ski. A non-contacting laser or sonar-type ski with at least four referencing mobile stations may be used with a reference at least 24 ft. (7.3 m) long. Under limited conditions, a short ski or shoe may be substituted for a long ski on the second paver operating in tandem, or when the reference plane is a newly placed adjacent lane.

Automatic screed control is required on all Projects; however, when the Engineer determines that Project conditions prohibit the use of such controls, the Engineer may waive the grade control, or slope control requirements, or both.

- e. Paver Screed Extension. When the laydown width requires a paver screed extension, use bolt-on screed extensions to extend the screeds, or use an approved mechanical screed extension device. When the screed is extended, add auger extensions to assure a length of no more than 18 inches from the auger to the end gate of the paver. Auger extensions may be omitted when paving variable widths. Ensure the paver is equipped with tunnel extensions when the screed and augers are extended.
- f. 30 - 45 Degree Wedge. When shown on/required by the plans, equip the paver to ensure a 30 degree minimum up to a 45 degree maximum wedge along the outside edge of the roadway (measured from the horizontal plane) is in place after final compaction on the final surface course. Use an approved mechanical device that will:
- Apply compactive effort to the asphalt mixture to eliminate objectionable voids as the mixture passes through the wedge device
 - Produce a wedge with a uniform texture, shape, and density while automatically adjusting to varying heights encountered along the roadway shoulder.

NOTE: Do not use extendible strike-off devices instead of approved screed extensions. Only use a strike-off device in areas that would normally be luted in by hand labor.

4. Compaction Equipment

Ensure that the compaction equipment is in good mechanical condition and can compact the mixture to the required density. The compaction equipment number, type, size, operation, and condition is subject to the Engineer's approval

5. Materials Transfer Vehicle (MTV)

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- a. Use a Materials Transfer Vehicle (MTV) when placing asphaltic concrete mixtures on Projects on the state route system with the following conditions. If a project fails to meet any one of the following conditions, the MTV's use is not required.
 - 1) When to use:
 - The ADT is equal to or greater than 6000,
 - The project length is equal to or greater than 3000 linear feet (915 linear meters),
 - The total tonnage (megagrams) of all asphaltic concrete mixtures is greater than 2000 tons (1815 Mg).
 - 2) Where to use:
 - Mainline of the traveled way
 - Collector/distributor (C/D) lanes on Interstates and limited access roadways
 - Leveling courses at the Engineer's discretion
 - 3) Do not use the MTV for the following conditions:
 - A resurfacing project that only 9.5 mm mix is required.
 - A project with lane width that is equal or less than 11 feet.
 - A passing lane only project.
 - When noted on the plans.
- b. Ensure the MTV and conventional paving equipment meet the following requirements:
 - 1) MTV
 - Has a truck unloading system which receives mixture from the hauling equipment and independently deliver mixtures from the hauling equipment to the paving equipment.
 - Has mixture remixing capability by either a storage bin in the MTV with a minimum capacity of 14 tons (13 megagrams) of mixture and a remixing system in the bottom of MTV storage bin, or a dual pugmill system located in the paver hopper insert with two full length transversely mounted paddle mixers to continuously blend the mixture as it discharges to a conveyor system.
 - Provides to the paver a homogeneous, non-segregated mixture of uniform temperature with no more than 20 °F(18 °C) difference between the highest and lowest temperatures when measured transversely across the width of the mat in a straight line at a distance of one foot to three feet from the screed while the paver is operating. Ensure that the MTV is capable of providing the paver a consistent material flow that is sufficient to prevent the paver from stopping between truck exchanges.
 - 2) Conventional Paving Equipment
 - Has a paver hopper insert with a minimum capacity of 14 tons (13 Mg) installed in the hopper of conventional paving equipment when an MTV is used.
- c. If the MTV malfunctions during spreading operations, discontinue placement of hot mix asphaltic concrete after there is sufficient hot mix placed to maintain traffic in a safe manner. However, placement of hot mix asphaltic concrete in a lift not exceeding 2 in. (50 mm) may continue until any additional hot mix in transit at the time of the malfunction has been placed. Cease spreading operations thereafter until the MTV is operational.
- d. Ensure the MTV is empty when crossing a bridge and is moved across without any other Contractor vehicles or equipment on the bridge. Move the MTV across a bridge in a travel lane and not on the shoulder. Ensure the speed of the MTV is no greater than 5 mph (8 kph) without any acceleration or deceleration while crossing a bridge.

400.3.03 Preparation

A. Prepare Existing Surface

Prepare the existing surface as follows:

1. Clean the Existing Surface. Before applying hot mix asphaltic concrete pavement, clean the existing surface to the Engineer's satisfaction.
2. Patch and Repair Minor Defects
Before placing leveling course:

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- a. Correct potholes and broken areas that require patching in the existing surface and base as directed by the Engineer.
 - b. Cut out, trim to vertical sides, and remove loose material from the areas to be patched.
 - c. Prime or tack coat the area after it has been cleaned. Compact patches to the Engineer’s satisfaction. Material for patches does not require a job mix formula, but shall meet the gradation range shown in [Section 828](#). The Engineer must approve the asphalt content to be used.
3. Apply Bituminous Tack Coat
- Apply the tack coat according to [Section 413](#). The Engineer will determine the application rate, which must be within the limitations Table 2.

Table 2—Application Rates for Bituminous Tack, gal/yd² (L/m²)

	Minimum	Maximum
Under OGFC and PEM Mixes	0.06 (0.270)	0.08 (0.360)
All Other Mixes	0.04 (0.180)	0.06(0.270)
*On thin leveling courses and freshly placed asphaltic concrete mixes, reduce the application rate to 0.02 to 0.04 gal/yd ² (0.09 to 0.18 L/m ²).		

B. Place Patching and Leveling Course

1. When the existing surface is irregular, bring it to the proper cross section and grade with a leveling course of hot mix asphaltic concrete materials.
2. Place leveling at the locations and in the amounts directed by the Engineer.
3. Use leveling course mixtures that meet the requirements of the job mix formulas defined in:
 - [Subsection 400.3.05.A, “Observe Composition of Mixtures”](#)
 - [Section 828](#)
 - Leveling acceptance schedules in [Subsection 400.3.06.A, “Acceptance Plans for Gradation and Asphalt Cement Content”](#)
4. If the leveling and patching mix type is undesignated, determine the mix type by the thickness or spread rate according to Table 3, but do not use 4.75 mm mix on interstate projects.

Table 3—Leveling and Patching Mix Types

Thickness	Rate of Spread	Type of Mix
Up to 0.75 in (19 mm)	Up to 85 lbs/yd ² (45 kg/m ²)	4.75 mm Mix or 9.5 mm Superpave Type 1
0.75 to 1.5 in (19 to 38 mm)	85 to 165 lbs/yd ² (45 to 90 kg/m ²)	9.5 mm Superpave Type 2
1.5 to 2 in (38 to 50 mm)	165 to 220 lbs/yd ² (90 to 120 kg/m ²)	12.5 mm Superpave *
2 to 2.5 in (50 to 64 mm)	220 to 275 lbs/yd ² (120 to 150 kg/m ²)	19 mm Superpave *
Over 2.5 in (64 mm)	Over 275 lbs/yd ² (150 kg/m ²)	25 mm Superpave

* These mixtures may be used for isolated patches no more than 6 in. (150 mm) deep and no more than 4 ft. (1.2 m) in diameter or length.

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400.3.04 Fabrication

General Provisions 101 through 150.

400.3.05 Construction

Provide the Engineer at least one day's notice prior to beginning construction, or prior to resuming production if operations have been temporarily suspended.

A. Observe Composition of Mixtures

1. Calibration of plant equipment

If the material changes, or if a component affecting the ingredient proportions has been repaired, replaced, or adjusted, check and recalibrate the proportions.

Calibrate as follows:

- a. Before producing mixture for the Project, calibrate by scale weight the electronic sensors or settings for proportioning mixture ingredients.
- b. Calibrate ingredient proportioning for all rates of production.

2. Mixture control

Compose hot mix asphaltic concrete from a uniform mixture of aggregates, bituminous material, and if required, hydrated lime, mineral filler, or other approved additive.

Make the constituents proportional to produce mixtures that meet the requirements in [Section 828](#). The general composition limits prescribed are extreme ranges within which the job mix formula must be established. Base mixtures on a design analysis that meets the requirements of [Section 828](#). Ensure that the field performance of the in-place mixtures meet the requirements of [Subsection 828.2B](#).

If control test results show that the characteristic tested does not conform to the job mix formula control tolerances given in [Section 828](#), take immediate action to ensure that the quality control methods are effective.

Control the materials to ensure that extreme variations do not occur. Maintain the gradation within the composition limits in [Section 828](#).

B. Prepare Bituminous Material

Uniformly heat the bituminous material to the temperature specified in the job mix formula with a tolerance of ± 20 °F (± 10 °C).

C. Prepare the Aggregate

Prepare the aggregate as follows:

1. Heat the aggregate for the mixture, and ensure a mix temperature within the limits of the job mix formula.
2. Do not contaminate the aggregate with fuel during heating.
3. Reduce the absorbed moisture in the aggregate until the asphalt does not separate from the aggregate in the prepared mixture. If this problem occurs, the Engineer will establish a maximum limit for moisture content in the aggregates. When this limit is established, maintain the moisture content below this limit.

D. Prepare the Mixture

Proportion the mixture ingredients as necessary to meet the required job mix formula. Mix until a homogenous mixture is produced.

1. Add Mineral Filler

When mineral filler is used, introduce it in the proper proportions and as specified in [Subsection 400.3.02.B.5, "Mineral Filler Supply System."](#)

2. Add Hydrated Lime

When hydrated lime is included in the mixture, add it at a rate specified in [Section 828](#) and the job mix formula. Use methods and equipment for adding hydrated lime according to [Subsection 400.3.02.B.6, "Hydrated Lime Treatment System."](#)

Add hydrated lime to the aggregate by using Method A or B as follows:

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Method A—Dry Form—Add hydrated lime in its dry form to the mixture as follows, according to the type of plant:

- a. Batch Type Asphalt Plant: Add hydrated lime to the mixture in the weigh hopper or as approved and directed by the Engineer.
- b. Continuous Plant Using Pugmill Mixer: Feed hydrated lime into the hot aggregate before it is introduced into the mixer so that dry mixing is complete before the bituminous material is added.
- c. Continuous Plant Using Drier-Drum Mixer: Add hydrated lime so that the lime will not become entrained into the air stream of the drier and so that thorough dry mixing will be complete before the bituminous material is added.

Method B—Lime/Water Slurry—Add the required quantity of hydrated lime (based on dry weight) in lime/water slurry form to the aggregate. This solution consists of lime and water in concentrations as directed by the Engineer.

Equip the plant to blend and maintain the hydrated lime in suspension and to mix it with the aggregates uniformly in the proportions specified.

3. Add Stabilizing Fiber

When stabilizing fiber is included in the mixture, add it at a rate specified in [Section 819](#) and the Job Mix Formula. Introduce it as specified in [Subsection 400.3.02.B.8, “Fiber Supply System.”](#)

4. Add Gilsonite Modifier

When required, add the Gilsonite modifier to the mixture at a rate such that eight percent by weight of the asphalt cement is replaced by Gilsonite. Use either PG 64-22 or PG 67-22 asphalt cement as specified in [Subsection 820.2.01](#). Provide suitable means to calibrate and check the rate of Gilsonite being added. Introduce Gilsonite modifier by either of the following methods.

- a. For batch type plants, incorporate Gilsonite into the pugmill at the beginning of the dry mixing cycle. Increase the dry mix cycle by a minimum of 10 seconds after the Gilsonite is added and prior to introduction of the asphalt cement. For this method, supply Gilsonite in plastic bags to protect the material during shipment and handling and store the modifier in a waterproof environment. The bags shall be capable of being completely melted and uniformly blended into the combined mixture.

Gilsonite may also be added through a mineral filler supply system as described in [Subsection 400.3.02.B.5, “Mineral Filler Supply System.”](#) The system shall be capable of injecting the modifier into the weigh hopper near the center of the aggregate batching cycle so the material can be accurately weighed.

- b. For drum drier plants, add Gilsonite through the recycle ring or through an acceptable means which will introduce the Gilsonite prior to the asphalt cement injection point. The modifier shall be proportionately fed into the drum mixer at the required rate by a proportioning device which shall be accurate within ± 10 percent of the amount required. The entry point shall be away from flames and ensure the Gilsonite will not be caught up in the air stream and exhaust system.

5. Materials from Different Sources

Do not use mixtures prepared from aggregates from different sources intermittently. This will cause the color of the finished pavement to vary.

E. Observe Weather Limitations

Do not mix and place asphaltic concrete if the existing surface is wet or frozen. Do not lay asphaltic concrete OGFC mix or PEM at air temperatures below 60 °F (16 °C). When using a MTV, OGFC mix or PEM may be placed at 55 °F (13 °C) when approved by the Engineer. For other courses, follow the temperature guidelines in the following table:

Table 4—Lift Thickness Table

Lift Thickness	Minimum Temperature
1 in (25 mm) or less	55 °F (13 °C)
1.1 to 2 in (26 mm to 50 mm)	45 °F (8 °C)
2.1 to 3 in (51 mm to 75 mm)	40 °F (4 °C)
3.1 to 4 in (76 mm to 100 mm)	35 °F (2 °C)
4.1 to 8 in (101 mm to 200 mm)	32 °F (0 °C) and rising. Base Material must not be frozen.

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F. Perform Spreading and Finishing

Spread and finish the course as follows:

1. Determine the course's maximum compacted layer thickness by the type mix being used according to Table 5.

Table 5—Maximum Layer Thickness

Mix Type	Minimum Layer Thickness	Maximum Layer Thickness	Maximum Total Thickness
25 mm Superpave	2 1/2 in (64 mm)	4 in (100 mm) *	—
19 mm Superpave	1 3/4 in (44 mm)	3 in (75 mm) *	—
12.5 mm Superpave	1 3/8 in (35 mm)	2 1/2 in (64 mm)*	8 in (200 mm)
9.5 mm Superpave Type 2	1 1/8 in.(28 mm)	1 1/2 in (38 mm)	4 in (100 mm)
9.5 mm Superpave Type 1	7/8 in (22 mm)	1 1/4 in (32 mm)	4 in (100 mm)
4.75 mm Mix	3/4 in (19 mm)	1 1/8 in (28 mm)	2 in (50 mm)
9.5 mm OGFC	55 lbs/yd ² (30 kg/m ²)	65 lbs/yd ² (36 kg/m ²)	—
12.5 mm OGFC	85 lbs/yd ² (47 kg/m ²)	95 lbs/yd ² (53 kg/m ²)	—
12.5 mm PEM	110 lbs/yd ² (80 kg/m ²)	165 lbs/yd ² (90 kg/m ²)	—
9.5 mm SMA	1 1/8 in (28 mm)	1 1/2 in (38 mm)	4 in (100 mm)
12.5 mm SMA	1 1/4 in (32 mm)	3 in (75 mm)	6 in (150 mm)
19 mm SMA	1 3/4 in (44 mm)	3 in (75 mm)	—
* Allow up to 6 in (150 mm) per lift on trench widening. Place 9.5 mm Superpave and 12.5 mm Superpave up to 4 in (100 mm) thick for driveway and side road transition.			

2. Unload the mixture into the paver hopper or into a device designed to receive the mixture from delivery vehicles.
3. Except for leveling courses, spread the mixture to the loose depth for the compacted thickness or the spread rate. Use a mechanical spreader true to the line, grade, and cross section specified.
4. For leveling courses, use a motor grader equipped with a spreader box and smooth tires to spread the material or use a mechanical spreader meeting the requirements in [Subsection 400.3.02.C, "Equipment at Project Site."](#)
5. Obtain the Engineer's approval for the sequence of paving operations, including paving the adjoining lanes. Minimize tracking tack onto surrounding surfaces.
6. Ensure that the outside edges of the pavement being laid are aligned and parallel to the roadway center line.
7. For New Construction or Resurfacing Contracts that contain multiple lifts or courses, arrange the width of the individual lifts so that the longitudinal joints of each successive lift are offset from the previous lift at least 1 ft (300 mm). This requirement does not apply to the lift immediately over thin lift leveling courses.
Ensure that the longitudinal joint(s) in the surface course and the mix immediately underneath asphaltic concrete OGFC or PEM are at the lane line(s).

NOTE: Perform night work with artificial light provided by the Contractor and approved by the Engineer.

8. Where mechanical equipment cannot be used, spread and rake the mixture by hand. Obtain the Engineer's approval of the operation sequence, including compactive methods, in these areas.
9. Keep small hand raking tools clean and free from asphalt build up. Do not use fuel oil or other harmful solvents to clean tools during the work.
10. Do not use mixture with any of these characteristics:
 - Segregated
 - Nonconforming temperature

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- Deficient or excessive asphalt cement content
 - Otherwise unsuitable to place on the roadway in the work
11. Remove and replace mixture placed on the roadway that the Engineer determines has unacceptable blemish levels from segregation, streaking, pulling and tearing, or other characteristics. Replace with acceptable mixture at the Contractor's expense. Do not continually place mixtures with deficiencies.
Do not place subsequent course lifts over another lift or courses placed on the same day while the temperature of the previously placed mix is 140 °F (60 °C) or greater.
 12. Obtain the Engineer's approval of the material compaction equipment. Perform the rolling as follows:
 - a. Begin the rolling as close behind the spreader as possible without causing excessive distortion of the asphaltic concrete surface.
 - b. Continue rolling until roller marks are no longer visible.
 - c. Use pneumatic-tired rollers with breakdown rollers on all courses except asphaltic concrete OGFC, PEM and SMA or other mixes designated by the Engineer.
 13. If applicable, taper or "feather" asphaltic concrete from full depth to a depth no greater than 0.5 in (13 mm) along curbs, gutters, raised pavement edges, and areas where drainage characteristics of the road must be retained. The Engineer will determine the location and extent of tapering.

G. Maintain Continuity of Operations

Coordinate plant production, transportation, and paving operations to maintain a continuous operation. If the spreading operations are interrupted, construct a transverse joint if the mixture immediately behind the paver screed cools to less than 250 °F (120 °C).

H. Construct the Joints

1. Construct Transverse Joints
 - a. Construct transverse joints to facilitate full depth exposure of the course before resuming placement of the affected course.
 - b. Properly clean and tack the vertical face of the transverse joint before placing additional material.

NOTE: Never burn or heat the joint by applying fuel oil or other volatile materials.

- c. Straightedge transverse joints immediately after forming the joint.
 - d. Immediately correct any irregularity that exceeds 3/16 in. in 10 ft (5 mm in 3 m).
2. Construct Longitudinal Joints
Clean and tack the vertical face of the longitudinal joint before placing adjoining material. Construct longitudinal joints so that the joint is smooth, well sealed, and bonded.
3. Construction Joint Detail for OGFC and PEM Mixtures

In addition to meeting joint requirements described above, construct joints and transition areas for 12.5 mm OGFC and 12.5 mm PEM mixtures as follows:

- a. For projects which do not have milling included as a pay item:
 - 1) Place OGFC mixture meeting gradation requirements of 9.5 mm OGFC as specified in [Section 828](#) on entrance and exit ramp gore areas and end of project construction joints.
 - Taper mixture from 3/8 in (10 mm) at end of project to full plan depth within maximum distance of spread for one load of mixture
 - Taper mixture placed on gore areas from thickness of the edge of the mainline to 3/8 in (10 mm) at the point of the ramp transverse joint.
 - 2) Construct the ramp transverse joint at the point specified in the plans or as directed by the Engineer.
 - 3) Mixture placed in the transition and gore areas will be paid for at the contract unit price for 12.5 mm OGFC or 12.5 mm PEM as applicable.
- b. For projects which have milling included as a pay item:
 - 1) Taper milling for a distance of no less than 50 ft (15 m) to a depth of 2 1/4 in (59 mm) at the point of the transverse joint

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- 2) Taper thickness, if needed, of the dense-graded surface mix within the 50 ft (15 m) distance to 1 1/2 in (40 mm) at the point of the transverse joint
- 3) Taper thickness of the 12.5 mm OGFC or 12.5 mm PEM to 3/4 in (19 mm) so that it ties in at grade level with the existing surface at the point of the transverse joint

I. Protect the Pavement

Protect sections of the newly finished pavement from traffic until the traffic will not mar the surface or alter the surface texture. If directed by the Engineer, use artificial methods to cool the newly finished pavement to open the pavement to traffic more quickly.

J. Modify the Job Mix Formula

If the Engineer determines that undesirable mixture or mat characteristics are being obtained, the job mix formula may require immediate adjustment.

400.3.06 Quality Acceptance

A. Acceptance Plans for Gradation and Asphalt Cement Content

The Contractor will randomly sample and test mixtures for acceptance on a lot basis. The Department will monitor the Contractor testing program and perform comparison and quality assurance testing.

1. Determine Lot Amount

A lot consists of the tons (megagrams) of asphaltic concrete produced and placed each production day. If this production is less than 500 tons (500 Mg), or its square yard (meter) equivalent, production may be incorporated into the next working day. The Engineer may terminate a lot when a pay adjustment is imminent if a plant or materials adjustment resulting in a probable correction has been made. Terminate all open lots at the end of the month, except for materials produced and placed during the adjustment period. The lot will be terminated as described in [Subsection 400.5.01, "Adjustments"](#).

If the final day's production does not constitute a lot, the production may be included in the lot for the previous day's run; or, the Engineer may treat the production as a separate lot with a corresponding lower number of tests.

2. Determine Lot Acceptance

Determine lot acceptance as found in [Subsection 400.5.01, "Adjustments."](#)

The Department will perform the following task:

Determine the pay factor by using the mean of the deviations from the job mix formula of the tests in each lot and apply it to Table 9—Mixture Acceptance Schedule for Surface Mixes or Table 10—Mixture Acceptance Schedule for Subsurface Mixes, whichever is appropriate. This mean will be determined by averaging the actual numeric value of the individual deviations from the job mix formula, disregarding whether the deviations are positive or negative amounts. Do not calculate lot acceptance using test results for materials not used in the Work. Determine the pay factor for each lot by multiplying the contract unit price by the appropriate pay factor from the Mixture Acceptance Schedule - Table 9 or Table 10. When two or more pay factors for a specific lot are less than 1.0, determine the adjusted payment by multiplying the contract unit price by the lowest pay factor.

If the mean of the deviations from the job mix formula of the lot acceptance tests for a control sieve or for asphalt cement content exceeds the tolerances established in the appropriate Mixture Acceptance Schedule, and if the Engineer determines that the material need not be removed and replaced, the lot may be accepted at an adjusted unit price as determined by the Engineer. If the Engineer determines that the material is not acceptable to leave in place, the materials shall be removed and replaced at the Contractor's expense.

3. Provide Quality Control Program

Provide a Quality Control Program as established in SOP 27 which includes:

- Assignment of quality control responsibilities to specifically named individuals who have been certified by the Office of Materials and Research
- Provisions for prompt implementation of control and corrective measures
- Provisions for communication with Project Manager, Bituminous Technical Services Engineer, and Testing Management Operations Supervisor at all times
- Provisions for reporting all test results daily through the Office of Materials and Research computerized Field Data Collection System; other checks, calibrations and records will be reported on a form developed by the Contractor and will be included as part of the project records

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- Notification in writing of any change in quality control personnel
- a. Certification Requirements:
- Use laboratory and testing equipment certified by the Department. (Laboratories which participate in and maintain AASHTO accreditation for testing asphaltic concrete mixtures will be acceptable in lieu of Departmental certification.)
 - Provide certified quality control personnel to perform the sampling and testing. A Quality Control Technician (QCT) may be certified at three levels:
 - 1) Temporary Certification – must be a technician trainee who shall be given direct oversight by a certified Level 1 or Level 2 QCT while performing acceptance testing duties during the first 5 days of training. The trainee must complete qualification requirements within 30 production days after being granted temporary certification. A trainee who does not become qualified within 30 production days will not be re-eligible for temporary certification. A certified Level 1 or Level 2 QCT shall be at the plant at all times during production and shipment of mixture to monitor work of the temporarily certified technician.
 - 2) Level 1 – must demonstrate they are competent in performing the process control and acceptance tests and procedures related to hot mix asphalt production and successfully pass a written exam.
 - 3) Level 2 – must meet Level 1 requirements and must be capable of and responsible for making process control adjustments, and successfully pass a written exam.
 - Technician certification is valid for 3 years from the date on the technician’s certificate unless revoked or suspended. Eligible technicians may become certified through special training and testing approved by the Office of Materials and Research. Technicians who lose their certification due to falsification of test data will not be eligible for recertification in the future unless approved by the State Materials and Research Engineer.
- b. Quality Control Management
- 1) Designate at least one Level 2 QCT as manager of the quality control operation. The Quality Control Manager shall meet the following requirements:
 - Be accountable for actions of other QCT personnel
 - Ensure that all applicable sampling requirements and frequencies, test procedures, and Standard Operating Procedures are adhered to
 - Ensure that all reports, charts, and other documentation is completed as required
 - 2) Provide QCT personnel at the plant as follows:
 - If daily production for all mix types is to be greater than 250 tons (megagrams), have a QCT person at the plant at all times during production and shipment of mixture until all required acceptance tests have been completed
 - If daily production for all mix types will not be greater than 250 tons (megagrams) a QCT may be responsible for conducting tests at up to two plants, subject to random number sample selection
 - Have available at the plant or within immediate contact by phone or radio a Level 2 QCT responsible for making prompt process control adjustments as necessary to correct the mix
 - 3) Sampling, Testing, and Inspection Requirements.

Provide all sample containers, extractants, forms, diaries, and other supplies subject to approval of the Engineer.

Perform daily sampling, testing, and inspection of mixture production that meets the following requirements:

 - (a) Randomly sample mixtures according to [GSP 15](#), and [GDT 73 \(Method C\)](#) and test on a lot basis. In the event less than the specified number of samples are taken, obtain representative 6 in (150 mm) cores from the roadway at a location where the load not sampled was placed. Take enough cores to ensure minimum sample size requirements are met for each sample needed.
 - (b) Maintain a printed copy of the computer generated random sampling data as a part of the project records.
 - (c) Perform sampling, testing, and inspection duties of [GSP 21](#).

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- (d) Perform extraction or ignition test ([GDT 83](#) or [GDT 125](#)) and extraction analysis ([GDT 38](#)). If the ignition oven is used, a printout of sample data including weights shall become a part of the project records. For asphalt cement content only, digital printouts of liquid asphalt cement weights may be substituted in lieu of an extraction test for plants with digital recorders. Calculate the asphalt content from the ticket representing the mixture tested for gradation.
- (e) Save extracted aggregate, opposite quarters, and remaining material (for possible referee testing) of each sample as follows:
 - Store in properly labeled, suitable containers
 - Secure in a protected environment
 - Store for three working days. If not obtained by the Department, within three days they may be discarded.
- (f) Add the following information on load tickets from which a sample or temperature check is taken:
 - Mixture temperature
 - Signature of the QCT person performing the testing
- (g) Calibrate the lime system when hydrated lime is included in the mixture:
 - Perform a minimum of twice weekly during production
 - Post results at the plant for review
 - Provide records of materials invoices upon request (including asphalt cement, aggregate, hydrated lime, etc.)
- (h) Take action if acceptance test results are outside Mixture Control Tolerances of [Section 828](#).
 - One sample out of tolerance
 - (1) Contact Level 2 - QCT to determine if a plant adjustment is needed
 - (2) Immediately run a process control sample. Make immediate plant adjustments if this sample is also out of tolerance

NOTE: Determine mixture temperature at least once per hour of production for OGFC and PEM mixes.

- (3) Test additional process control samples as needed to ensure corrective action taken appropriately controls the mixture
 - Two consecutive acceptance samples of the same mix type out of tolerance regardless of Lot or mix design level, or three consecutive acceptance samples out of tolerance regardless of mix type
 - (1) Stop plant production immediately
 - (2) Reject any mixture already in storage that:
 - Deviates more than 10 percent in gradation from the job mix formula based on the acceptance sample
 - Deviates more than 0.7 percent in asphalt content from the job mix formula based on the acceptance sample
 - (3) Make a plant correction to any mix type out of tolerance prior to resuming production
 - Do not send any mixture to the project before test results of a process control sample meets Mixture Control Tolerances
 - Reject any mixture produced at initial restarting that does not meet Mixture Control Tolerances
- 4) Comparison Testing and Quality Assurance Program
- Periodic comparison testing by the Department will be required of each QCT to monitor consistency of equipment and test procedures. The Department will take independent samples to monitor the Contractor's quality control program.
- a) Comparison Sampling and Testing

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Retain samples for comparison testing and referee testing if needed as described in [Subsection 400.3.06.A.3.b.3](#). Discard these samples only if the Contractor's acceptance test results meet a 1.00 pay factor and the Department does not procure the samples within three working days.

The Department will test comparison samples on a random basis. Results will be compared to the respective contractor acceptance tests and the maximum difference shall be as follows:

Table 6—Allowable Percent Difference Between Department and Contractor Acceptance Tests

<u>SIEVE SIZE</u>	<u>SURFACE</u>	<u>SUB-SURFACE</u>
1/2 in. (12.5 mm)		4.0%
3/8 in. (9.5 mm)	3.5%	4.0%
No. 4 (4.75 mm)	3.5%	3.5%
No. 8 (2.36 mm)	2.5%	3.0%
No. 200 (75 µm)	2.0%	2.0%
A.C.	0.4%	0.5%

NOTE: Pavement courses to be overlaid with OGFC or PEM mixes are considered surface mixes.

- (1) If test comparisons are within these tolerances:
 - Continue production
 - Use the Contractor's tests for acceptance of the lot
 - (2) If test comparisons are not within these tolerances:
 - Another Departmental technician will test the corresponding referee sample
 - Results of the referee sample will be compared to the respective contractor and Departmental tests using the tolerance for comparison samples given above.
 - (a) If referee test results are within the above tolerances when compared to the Contractor acceptance test, use the Contractor's test for acceptance of the effected lot.
 - (b) If referee test results are not within the above tolerances when compared to the Contractor acceptance test, the Department will review the Contractor's quality control methods and determine if a thorough investigation is needed.
- b) Quality Assurance Sampling and Testing
- (1) Randomly take a minimum of two quality assurance samples from the lesser of five days or five lots of production regardless of mix type or number of projects.
 - (2) Compare test deviation from job mix formula to Mixture Control Tolerances in [Section 828](#). If results are outside these tolerances, another sample from the respective mix may be taken.

NOTE: For leveling courses less than 110 lb/yd² (60 kg/m²) that have quality assurance test results outside the Mixture Control Tolerances of [Section 828](#), use the Department's test results only and applicable pay factors will apply.

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If test results of the additional sample are not within Mixture Control Tolerances, the Department will take the following action:

- Take random samples from throughout the lot as in [Subsection 400.3.06.A.3.b.3](#) and use these test results for acceptance and in calculations for the monthly plant rating. Applicable pay factors will apply and the contractor QCT test results will not be included in pay factor calculations nor in the monthly plant rating.
- Determine if the Contractor's quality control program is satisfactory and require prompt corrective action by the Contractor if specification requirements are not being met.
- Determine if the QCT has not followed Departmental procedures or has provided erroneous information.
- Take samples of any in-place mixture represented by unacceptable QCT tests and use the additional sample results for acceptance and in calculations for the monthly plant rating and apply applicable pay factors. The Contractor QCT tests will not be included in the pay factor calculations nor in the monthly plant rating.

B. Compaction

Determine the mixture compaction using either [GDT 39](#) or [GDT 59](#). The compaction is accepted in lots defined in [Subsection 400.3.06. A “Acceptance Plans for Gradation and Asphalt Cement Content”](#) and is within the same lot boundaries as the mixture acceptance.

1. Calculate Pavement Mean Air Voids

The Department will calculate the pavement air voids placed within each lot as follows:

- a. One test per sub-lot.
- b. Average the results of all tests run on randomly selected sites in that lot.
- c. Select the random sites using [GDT 73](#).

Density tests are not required for asphaltic concrete placed at 90 lbs/yd² (50 kg/m²) or less, 4.75 mm mix, and asphaltic concrete OGFC, PEM and mixes placed as variable depth or width leveling. Compact these courses to the Engineer’s satisfaction. Density tests will not be performed on turn-outs and driveways.

The targeted maximum Pavement Mean Air Void content for all Superpave and Stone Matrix Asphalt mixtures is 5.0 percent. Ensure that the maximum Pavement Mean Air Voids for all Superpave and Stone Matrix Asphalt mixtures does not exceed 7.0 percent. The maximum Pavement Mean Air Voids for 2 foot shoulder widening is 9.0 percent. The adjustment period for density shall be four lots or four production days, whichever is less, in order for the contractor to ensure maximum compactive effort has been achieved which will yield no more than the specified maximum allowed Mean Air Voids. If the contractor needs to adjust the mixture to improve density results, a change in the job mix formula may be requested for approval during the adjustment period so long as the following values are not exceeded:

- Coarse pay sieve ± 4%
- No. 8 (2.36 mm) sieve ± 2%
- No. 200 (75 µm) sieve ± 1%
- Asphalt Content ± 0.2%
- All value changes must still be within specification limits

If the Office of Materials and Research is satisfied that the contractor has exerted the maximum compactive effort and is not able to maintain Pavement Mean Air Voids at no more than 7.0%, the Engineer may establish a maximum target for Pavement Mean Air Voids.

Mixture placed during the adjustment period for density shall meet the requirements for a 0.90 pay factor in Table 12 of [Subsection 400.5.01.C, “Calculate Mean Pavement Air Voids.”](#) Mixture which does not meet these density requirements shall be paid for using the applicable pay factor.

If the mean air voids of the pavement placed within a lot exceeds 100% of the maximum target air voids, if established and the Engineer determines that the material need not be removed and replaced, the lot may be accepted at an adjusted unit price as determined by the Engineer.

2. Obtain Uniform Compaction

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For a lot to receive a pay factor of 1.00 for compaction acceptance, the air void range cannot exceed 4 percent for new construction or 5 percent for resurfacing projects. The range is the difference between the highest and lowest acceptance test results within the affected lot. If the air void range exceeds these tolerances, apply a Pay Factor of 95%.

The 5% reduced pay factor for the compaction range does not apply in these instances:

- The mixture is placed during the adjustment period as defined in [Subsection 400.5.01.A, “Materials Produced and Placed During the Adjustment Period.”](#)
- All air void results within a given lot are less than 7.0%.
- A lot containing two subplot or less.
- On two foot trench widening.

C. Surface Tolerance

In this Specification, pavement courses to be overlaid with an Open-Graded Friction Course or PEM are considered surface courses. All Open-Graded Friction Courses or PEM are to be evaluated after the roadway has been opened to traffic for a minimum of 5 days and a maximum of 15 days. Other asphalt paving is subject to straightedge and visual inspection and irregularity correction as shown below:

1. Visual and Straightedge Inspection

Paving is subject to visual and straightedge inspection during and after construction operations until Final Acceptance. Locate surface irregularities as follows:

- a. Keep a 10 ft (3 m) straightedge near the paving operation to measure surface irregularities on courses. Provide the straightedge and the labor for its use.
- b. Inspect the base, intermediate, and surface course surfaces with the straightedge to detect irregularities.
- c. Correct irregularities that exceed 3/16 in. in 10 ft (5 mm in 3 m) for base and intermediate courses, and 1/8 in. in 10 ft (3 mm in 3 m) for surface courses.

Mixture or operating techniques will be stopped if irregularities such as rippling, tearing, or pulling occur and the Engineer suspects a continuing equipment problem. Stop the paving operation and correct the problem. Correct surface course evaluations on individual Laser Road Profiler test sections, normally 1 mile (1 km) long.

2. Target Surface Smoothness

The Department will use the Laser Road Profiler method to conduct acceptance testing for surface course tolerance according to [GDT 126](#). This testing will be performed only on:

- Surface courses on Projects with mainline traveled way measuring a minimum distance of 1 mile
- Ramps more than 0.5 mile (800 m) long

Achieve the smoothest possible ride during construction. Do not exceed the target Laser Road Profiler smoothness index as shown below:

Table 7—Pavement Smoothness Requirements—New Construction

Construction Description	Smoothness Index
Asphaltic concrete OGFC and PEM on interstates and asphaltic concrete OGFC and PEM on new construction on state routes	750
Asphaltic Concrete SMA and other resurfacing on interstates, asphaltic concrete OGFC and PEM resurfacing on state routes, and new construction	825
All other resurfacing on state routes (excluding LARP, PR, airports, etc.)	900

If the target values are not achieved, immediately adjust the operations to meet the target values.

Corrective work is required if the surface smoothness exceeds the Laser Road Profiler smoothness index shown below:

Table 8—Pavement Smoothness Requirements—Corrective Work

Construction Description	Smoothness Index
Asphaltic concrete OGFC and PEM on interstates and asphaltic concrete OGFC and PEM on new construction on state routes	825
Asphaltic Concrete SMA and other resurfacing on interstates, asphaltic concrete OGFC and PEM resurfacing on state routes, and new construction	900
All other resurfacing on state routes (excluding LARP, PR, airports, etc.)	1025

If surface tolerance deficiencies need correction, obtain the Engineer’s approval of the methods and type mix used.

3. Bridge Approach Ride Quality

The following are subject to a ride quality test by the Department for 100 ft. (30 m) of roadway approaching each end of a bridge using the Lightweight Profiler:

- A state road with 4 lanes or more
- A 2-lane state road with a current traffic count of 2,000 vpd or more
- Locations designated on the Plans

All other bridge approaches shall meet the 1/8 in. in 10 ft (3 mm in 3 m) straightedge requirement. Test ride quality as follows:

- a. The Department will determine a profile index value according to test method [GDT 134](#).
- b. The Department will average the profile index value from the right and left wheelpath for each 100 ft (30 m) section for each lane. Keep the profile index value under 30 in/mile (475 mm/km).
- c. Meet the profile index value for the 100 ft (30 m) section of roadway up to the joint with the approach slab.
- d. Schedule the ride quality testing 5 days before needed by contacting the Office of Materials and Research. Clean and clear obstructions from the test area.
- e. Correct the sections that do not meet the ride quality criteria of this Specification. After correction, these sections are subject to retesting with the Lightweight Profiler. The Engineer shall direct the type of correction method, which may include:
 - Milling
 - Grinding
 - Removing and replacing the roadway

No additional compensation will be made.

The Department will perform ride quality testing up to two times on the bridge approaches at no cost to the Contractor. Additional profilograph testing will cost the Contractor \$500 per test.

D. Reevaluation of Lots

When lots are reevaluated as shown in [Subsection 106.03, “Samples, Tests, Cited Specifications.”](#) sampling and testing is according to [GDT 73](#). Request for reevaluation shall be made within 5 working days of notification of the lot results. The following procedures apply:

1. Mixture Acceptance

The Department will take the same number of new tests on cores taken at a location where the load sampled was placed and will use only those core results for acceptance.

The Department will use the mean of the deviations from the job mix formula for these tests to determine acceptance based on the appropriate column in the Asphalt Cement Content and Aggregate Gradation of Asphalt Concrete [Mixture Acceptance Schedule—Table 9 or 10](#).

2. Compaction Acceptance

The Department will reevaluate the lot through additional testing by cutting the same number of cores originally obtained and averaging these results with the results from the original density tests. The Department will use the

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average to determine acceptance according to the Compaction Acceptance Schedule in [Subsection 400.5.01.C](#), “[Calculate Pavement Mean Air Voids](#)”.

Table 9—Mixture Acceptance Schedule—Surface Mixes

Mixture Characteristics	Pay Factor	Mean of the Deviations from the Job Mix Formula							
		1 Test	2 Tests	3 Tests	4 Tests	5 Tests	6 Tests	7 Tests	8 Tests
Asphalt Cement Content (Extraction, Ignition)	1.00	0.00 - 0.70	0.00 - 0.54	0.00 - 0.46	0.00 - 0.41	0.00 - 0.38	0.00 - 0.35	0.00 - 0.32	0.00 - 0.30
	0.95	0.71 - 0.80	0.55 - 0.61	0.47 - 0.52	0.42 - 0.46	0.39 - 0.43	0.36 - 0.39	0.33 - 0.36	0.31 - 0.34
	0.90	0.81 - 0.90	0.62 - 0.68	0.53 - 0.58	0.47 - 0.51	0.44 - 0.47	0.40 - 0.45	0.37 - 0.40	0.35 - 0.37
	0.80	0.91 - 1.00	0.69 - 0.75	0.59 - 0.64	0.52 - 0.56	0.48 - 0.52	0.44 - 0.47	0.41 - 0.44	0.38 - 0.41
	0.70	1.01 - 1.19	0.76 - 0.82	0.65 - 0.69	0.57 - 0.61	0.53 - 0.56	0.48 - 0.51	0.45 - 0.47	0.42 - 0.44
	0.50	1.20 - 1.40	0.83 - 0.85	0.70 - 0.72	0.62 - 0.64	0.57 - 0.59	0.52 - 0.55	0.48 - 0.51	0.45 - 0.48
3/8 in. (9.5 mm) Sieve (12.5 mm OGFC, 12.5 mm PEM, 12.5 mm Superpave)	1.00	0.00 - 0.9	0.00 - 6.6	0.00 - 5.6	0.00 - 5.0	0.00 - 4.6	0.00 - 4.2	0.00 - 3.9	0.00 - 3.6
	0.98	9.1 - 10.0	6.7 - 7.5	5.7 - 6.3	5.1 - 5.6	4.7 - 5.2	4.3 - 4.7	4.0 - 4.4	3.7 - 4.1
	0.95	10.1 - 11.9	7.6 - 8.4	6.4 - 7.0	5.7 - 6.3	5.3 - 5.8	4.8 - 5.3	4.5 - 5.0	4.2 - 4.6
	0.90	12.0 - 13.0	8.5 - 9.3	7.1 - 7.7	6.4 - 6.9	5.9 - 6.3	5.4 - 5.8	5.1 - 5.4	4.7 - 5.0
	0.85	13.1 - 14.0	9.4 - 10.2	7.8 - 8.6	7.0 - 7.6	6.4 - 6.9	5.9 - 6.3	5.5 - 5.9	5.1 - 5.5
	0.80	14.1 - 14.5	10.3 - 10.5	8.7 - 8.9	7.7 - 8.0	7.0 - 7.5	6.4 - 6.8	6.0 - 6.4	5.6 - 6.0
3/8 in. (9.5 mm) Sieve (12.5 mm SMA)	1.00	0.0 - 6.8	0.00 - 5.0	0.00 - 4.2	0.00 - 3.8	0.00 - 3.4	0.00 - 3.2	0.00 - 2.9	0.00 - 2.7
	0.98	6.9 - 7.5	5.1 - 5.6	4.6 - 4.7	3.9 - 4.2	3.5 - 3.9	3.3 - 3.5	3.0 - 3.3	2.8 - 3.1
	0.95	7.6 - 8.9	5.7 - 6.3	4.8 - 5.2	4.3 - 4.7	4.0 - 4.4	3.6 - 4.0	3.4 - 3.8	3.2 - 3.4
	0.90	9.0 - 9.8	6.4 - 7.0	5.3 - 5.8	4.8 - 5.2	4.5 - 4.8	4.1 - 4.4	3.9 - 4.1	3.5 - 3.8
	0.85	9.9 - 10.5	7.1 - 7.6	5.9 - 6.4	5.3 - 5.7	4.9 - 5.2	4.5 - 4.7	4.2 - 4.4	3.9 - 4.1
	0.80	10.6 - 10.9	7.7 - 7.9	6.5 - 6.7	5.8 - 6.0	5.3 - 5.6	4.8 - 5.1	4.5 - 4.8	4.2 - 4.5
No. 4 (4.75 mm) Sieve (9.5 mm OGFC, 9.5 mm Superpave)	1.00	0.00 - 9.0	0.00 - 6.7	0.00 - 5.7	0.00 - 5.2	0.00 - 4.8	0.00 - 4.4	0.00 - 4.1	0.00 - 3.8
	0.98	9.1 - 10.0	6.8 - 7.6	5.8 - 6.3	5.3 - 5.8	4.9 - 5.4	4.5 - 4.9	4.2 - 4.6	3.9 - 4.3
	0.95	10.1 - 11.9	7.7 - 8.5	6.4 - 6.9	5.9 - 6.4	5.5 - 5.9	5.0 - 5.4	4.7 - 5.0	4.4 - 4.7
	0.90	12.0 - 13.0	8.6 - 9.4	7.0 - 7.5	6.5 - 7.0	6.0 - 6.5	5.5 - 5.9	5.1 - 5.5	4.8 - 5.1
	0.85	13.1 - 14.0	9.5 - 10.2	7.6 - 8.0	7.1 - 7.6	6.6 - 7.0	6.0 - 6.4	5.6 - 5.9	5.2 - 5.5
	0.80	14.1 - 14.5	10.3 - 10.5	8.1 - 8.3	7.7 - 8.0	7.1 - 7.5	6.5 - 6.9	6.0 - 6.4	5.6 - 5.9
No. 4 (4.75 mm) Sieve	1.00	0.00 - 6.8	0.00 - 5.0	0.00 - 4.3	0.00 - 3.9	0.00 - 3.6	0.00 - 3.3	0.00 - 3.1	0.00 - 2.8

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Mixture Characteristics	Pay Factor	Mean of the Deviations from the Job Mix Formula							
		1 Test	2 Tests	3 Tests	4 Tests	5 Tests	6 Tests	7 Tests	8 Tests
(9.5 mm SMA)	0.98	6.9 - 7.5	5.1 - 5.7	4.4 - 4.7	4.0 - 4.4	3.7 - 4.0	3.4 - 3.7	3.2 - 3.4	2.9 - 3.2
	0.95	7.6 - 8.9	5.8 - 6.4	4.8 - 5.2	4.5 - 4.8	4.1 - 4.4	3.8 - 4.0	3.5 - 3.8	3.3 - 3.5
	0.90	9.0 - 9.8	6.5 - 7.0	5.3 - 5.6	4.9 - 5.2	4.5 - 4.9	4.1 - 4.4	3.9 - 4.1	3.6 - 3.8
	0.85	9.9 - 10.5	7.1 - 7.7	5.7 - 6.0	5.3 - 5.7	5.0 - 5.2	4.3 - 4.8	4.2 - 4.4	3.9 - 4.1
	0.80	10.6 - 10.9	7.8 - 7.9	6.1 - 6.2	5.8 - 6.0	5.3 - 5.6	4.9 - 5.2	4.5 - 4.8	4.2 - 4.4
No. 8 (2.36 mm) Sieve (OGFC, PEM, Superpave and 4.75 mm mixes)	1.00	0.00 - 7.0	0.00 - 5.6	0.00 - 4.8	0.00 - 4.3	0.00 - 4.0	0.00 - 3.6	0.00 - 3.4	0.00 - 3.2
	0.98	7.1 - 8.0	5.7 - 6.3	4.9 - 5.4	4.4 - 4.8	4.1 - 4.5	3.7 - 4.1	3.5 - 3.8	3.3 - 3.6
	0.95	8.1 - 9.0	6.4 - 7.0	5.5 - 6.0	4.9 - 5.3	4.6 - 4.9	4.2 - 4.5	3.9 - 4.2	3.7 - 3.9
	0.90	9.1 - 10.9	7.1 - 7.7	6.1 - 6.6	5.4 - 5.8	5.0 - 5.4	4.6 - 4.9	4.3 - 4.6	4.0 - 4.3
	0.85	11.0 - 12.0	7.8 - 8.5	6.7 - 7.2	5.9 - 6.4	5.5 - 5.8	5.0 - 5.3	4.7 - 5.0	4.4 - 4.6
	0.75	12.1 - 12.5	8.6 - 8.8	7.3 - 7.5	6.5 - 6.8	5.9 - 6.3	5.4 - 5.7	5.1 - 5.3	4.7 - 4.9
No. 8 (2.36 mm) Sieve (12.5 mm SMA, 9.5 mm SMA)	1.00	0.00 - 5.3	0.00 - 4.2	0.00 - 3.6	0.00 - 3.2	0.00 - 3.0	0.00 - 2.7	0.00 - 2.6	0.00 - 2.4
	0.98	5.4 - 6.0	4.3 - 4.7	3.7 - 4.0	3.3 - 3.6	3.1 - 3.4	2.8 - 3.1	2.7 - 2.9	2.5 - 2.7
	0.95	6.1 - 6.8	4.8 - 5.3	4.1 - 4.5	3.7 - 4.0	3.5 - 3.7	3.2 - 3.4	3.0 - 3.2	2.8 - 2.9
	0.90	6.9 - 8.2	5.4 - 5.8	5.6 - 5.0	4.1 - 4.5	3.8 - 4.0	3.5 - 3.7	3.3 - 3.5	3.0 - 3.2
	0.85	8.3 - 9.0	5.9 - 6.4	5.1 - 5.4	4.6 - 4.8	4.1 - 4.4	3.8 - 4.0	3.6 - 3.8	3.3 - 3.4
	0.75	9.1 - 9.4	6.5 - 6.6	5.5 - 5.0	4.9 - 5.1	4.5 - 4.7	4.1 - 4.3	3.9 - 4.0	3.5 - 3.7
No. 8 (2.36 mm) Sieve for OGFC and PEM mixes: When the mean of the deviations from the Job Mix Formula for a particular lot exceeds the tolerance for a 1.00 pay factor in the appropriate column, the lot will be paid for at 0.50 of the Contract Price.									

Table 10—Mixture Acceptance Schedule—Subsurface Mixes

Mixture Characteristics	Pay Factor	Mean of the Deviations from the Job Mix Formula							
		1 Test	2 Tests	3 Tests	4 Tests	5 Tests	6 Tests	7 Tests	8 Tests
Asphalt Cement Content (Extraction, Ignition)	1.00	0.00 - 0.80	0.00 - 0.61	0.00 - 0.52	0.00 - 0.46	0.00 - 0.43	0.00 - 0.39	0.00 - 0.36	0.00 - 0.34
	0.95	0.81 - 0.90	0.62 - 0.68	0.53 - 0.58	0.47 - 0.51	0.44 - 0.47	0.40 - 0.43	0.37 - 0.40	0.35 - 0.37
	0.90	0.91 - 1.00	0.69 - 0.75	0.59 - 0.64	0.52 - 0.56	0.48 - 0.52	0.44 - 0.47	0.41 - 0.44	0.38 - 0.41
	0.80	1.01 - 1.19	0.76 - 0.82	0.65 - 0.69	0.57 - 0.61	0.53 - 0.56	0.48 - 0.51	0.45 - 0.47	0.42 - 0.44
	0.70	1.20 - 1.40	0.83 - 0.85	0.70 - 0.72	0.62 - 0.64	0.57 - 0.59	0.52 - 0.55	0.48 - 0.51	0.45 - 0.48
	0.50	1.41 - 1.60	0.86 - 0.88	0.73 - 0.75	0.65 - 0.67	0.60 - 0.63	0.56 - 0.60	0.52 - 0.56	0.49 - 0.52
1/2 in. (12.5 mm) Sieve (25 mm Superpave)	1.00	0.00 - 12.9	0.00 - 8.1	0.00 - 6.9	0.00 - 6.1	0.00 - 5.5	0.00 - 5.0	0.00 - 4.7	0.00 - 4.4
	0.98	13.0 - 14.0	8.2 - 9.1	7.0 - 7.7	6.2 - 6.8	5.6 - 6.1	5.1 - 5.6	4.8 - 5.2	4.5 - 4.9
	0.95	14.1 - 15.0	9.2 - 10.1	7.8 - 8.5	6.9 - 7.5	6.2 - 6.7	5.7 - 6.1	5.3 - 5.7	5.0 - 5.4
	0.90	15.1 - 16.0	10.2 - 11.1	8.6 - 9.3	7.6 - 8.2	6.8 - 7.4	6.2 - 6.7	5.8 - 6.3	5.5 - 5.9
	0.85	16.1 - 17.0	11.2 - 11.5	9.4 - 9.6	8.3 - 8.6	7.5 - 7.8	6.8 - 7.0	6.4 - 6.5	6.0 - 6.1
	0.80	17.1 - 18.0	11.6 - 11.9	9.7 - 9.9	8.7 - 9.0	7.9 - 8.1	7.1 - 7.3	6.6 - 6.8	6.2 - 6.4
1/2 in. (12.5 mm) Sieve (19 mm SMA)	1.00	0.00 - 9.7	0.00 - 6.0	0.00 - 5.2	0.00 - 4.6	0.00 - 4.1	0.00 - 3.8	0.00 - 3.5	0.00 - 3.3
	0.98	9.8 - 10.5	6.2 - 6.8	5.3 - 5.8	4.7 - 5.1	4.2 - 4.6	3.9 - 4.2	3.6 - 3.9	3.4 - 3.7
	0.95	10.6 - 11.2	6.9 - 7.8	5.9 - 6.4	5.2 - 5.6	4.7 - 5.0	4.3 - 4.6	4.0 - 4.3	3.8 - 4.0
	0.90	11.3 - 12.0	7.9 - 8.3	6.5 - 7.0	5.7 - 6.1	5.1 - 5.6	4.7 - 5.0	4.4 - 4.7	4.1 - 4.4
	0.85	12.1 - 12.8	8.4 - 8.6	7.1 - 7.2	6.2 - 6.5	5.7 - 5.9	5.1 - 5.3	4.8 - 4.9	4.5 - 5.6
	0.80	12.9 - 13.5	8.7 - 8.9	7.3 - 7.4	6.6 - 6.8	6.0 - 6.1	5.4 - 5.5	5.0 - 5.1	4.7 - 4.8
3/8 in. (9.5 mm) Sieve (19 mm Superpave, 12.5 mm Superpave)	1.00	0.00 - 10.0	0.00 - 7.5	0.00 - 6.3	0.00 - 5.6	0.00 - 5.2	0.00 - 4.7	0.00 - 4.4	0.00 - 4.1
	0.98	10.1 - 11.9	7.6 - 8.4	6.4 - 7.0	5.7 - 6.3	5.3 - 5.8	4.8 - 5.3	4.5 - 5.0	4.2 - 4.6
	0.95	12.0 - 13.0	8.5 - 9.3	7.1 - 7.7	6.4 - 6.9	5.9 - 6.3	5.4 - 5.8	5.1 - 5.4	4.7 - 5.0
	0.90	13.1 - 14.0	9.4 - 10.2	7.8 - 8.6	7.0 - 7.6	6.4 - 6.9	5.9 - 6.3	5.5 - 5.9	5.1 - 5.5
	0.85	14.1 - 14.5	10.3 - 10.5	8.7 - 8.9	7.7 - 8.0	7.0 - 7.5	6.4 - 6.8	6.0 - 6.4	5.6 - 6.0
	0.80	14.6 - 15.0	10.6 - 10.8	9.0 - 9.2	8.1 - 8.4	7.6 - 7.8	6.9 - 7.3	6.5 - 6.8	6.1 - 6.5
No. 4 (4.75 mm) Sieve	1.00	0.00 - 10.0	0.00 - 7.6	0.00 - 6.3	0.00 - 5.8	0.00 - 5.4	0.00 - 4.9	0.00 - 4.6	0.00 - 4.3

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Mixture Characteristics	Pay Factor	Mean of the Deviations from the Job Mix Formula							
		1 Test	2 Tests	3 Tests	4 Tests	5 Tests	6 Tests	7 Tests	8 Tests
(9.5 mm Superpave)	0.98	10.1 - 11.9	7.7 - 8.5	6.4 - 6.9	5.9 - 6.4	5.5 - 5.9	5.0 - 5.4	4.7 - 5.0	4.4 - 4.7
	0.95	12.0 - 13.0	8.6 - 9.4	7.0 - 7.5	6.5 - 7.0	6.0 - 6.5	5.5 - 5.9	5.1 - 5.5	4.8 - 5.1
	0.90	13.1 - 14.0	9.5 - 10.2	7.6 - 8.0	7.1 - 7.6	6.6 - 7.0	6.0 - 6.4	5.6 - 5.9	5.2 - 5.5
	0.85	14.1 - 14.5	10.3 - 10.5	8.1 - 8.3	7.7 - 8.0	7.1 - 7.5	6.5 - 6.9	6.0 - 6.4	5.6 - 5.9
	0.80	14.6 - 15.0	10.6 - 10.8	8.4 - 8.6	8.1 - 8.4	7.6 - 8.0	7.0 - 7.4	6.5 - 6.8	6.0 - 6.3
No. 8 (2.36 mm) Sieve (All mixes except SMA)	1.00	0.00 - 8.0	0.00 - 6.3	0.00 - 5.4	0.00 - 4.8	0.00 - 4.5	0.00 - 4.1	0.00 - 3.8	0.00 - 3.6
	0.98	8.1 - 9.0	6.4 - 7.0	5.5 - 6.0	4.9 - 5.3	4.6 - 4.9	4.2 - 4.5	3.9 - 4.2	3.7 - 3.9
	0.95	9.1 - 10.0	7.1 - 7.7	6.1 - 6.6	5.4 - 5.8	5.0 - 5.4	4.6 - 4.9	4.3 - 4.6	4.0 - 4.3
	0.90	10.1 - 11.9	7.8 - 8.5	6.7 - 7.2	5.9 - 6.4	5.5 - 5.8	5.0 - 5.3	4.7 - 5.0	4.4 - 4.6
	0.85	12.0 - 13.0	8.6 - 8.8	7.3 - 7.5	6.5 - 6.8	5.9 - 6.3	5.4 - 5.7	5.1 - 5.3	4.7 - 4.9
	0.75	13.1 - 14.0	8.9 - 9.1	7.6 - 7.8	6.9 - 7.2	6.4 - 6.6	5.8 - 6.1	5.4 - 5.7	5.0 - 5.3
No. 8 (2.36 mm) Sieve (19 mm SMA)	1.00	0.00 - 6.0	0.00 - 4.7	0.00 - 4.1	0.00 - 3.6	0.00 - 3.4	0.00 - 3.1	0.00 - 2.9	0.00 - 2.4
	0.98	6.1 - 6.8	4.8 - 5.2	4.2 - 4.5	3.7 - 4.0	3.5 - 3.7	3.2 - 3.4	3.0 - 3.2	2.8 - 2.9
	0.95	6.9 - 7.5	5.3 - 5.8	4.6 - 5.0	4.1 - 4.4	3.8 - 4.0	3.5 - 3.7	3.3 - 3.5	3.0 - 3.2
	0.90	7.6 - 8.9	5.9 - 6.4	5.1 - 5.4	4.5 - 4.8	4.1 - 4.4	3.8 - 4.0	3.6 - 3.8	3.3 - 3.5
	0.85	9.0 - 9.8	6.5 - 6.6	5.5 - 5.6	4.9 - 5.1	4.5 - 4.7	4.1 - 4.3	3.9 - 4.0	3.6 - 3.7
	0.75	9.9 - 10.5	6.7 - 6.8	5.7 - 5.9	5.2 - 5.4	4.8 - 5.0	4.4 - 4.6	4.1 - 4.3	3.8 - 4.0

E. Segregated Mixture

Prevent mixture placement that yields a segregated mat by following production, storage, loading, placing, and handling procedures. Also, make needed plant modifications and provide necessary auxiliary equipment. (See [Subsection 400.1.01, "Definitions."](#))

If the mixture is segregated in the finished mat, the Department will take actions based on the degree of segregation. The actions are described below.

1. Unquestionably Unacceptable Segregation

When the Engineer determines that the segregation in the finished mat is unquestionably unacceptable, follow these measures:

- a. Suspend Work and require the Contractor to take positive corrective action. The Department will evaluate the segregated areas to determine the extent of the corrective work to the in-place mat as follows:
 - Perform extraction and gradation analysis by taking 6 in (150 mm) cores from typical, visually unacceptable segregated areas.
 - Determine the corrective work according to [Subsection 400.3.06.E.3](#).
- b. Require the Contractor to submit a written plan of measures and actions to prevent further segregation. Work will not continue until the plan is submitted to and approved by the Department.
- c. When work resumes, place a test section not to exceed 500 tons (500 Mg) of the affected mixture for the Department to evaluate. If a few loads show that corrective actions were not adequate, follow the measures above beginning with step 1.a. above. If the problem is solved, Work may continue.

2. Unacceptable Segregation Suspected

When the Engineer observes segregation in the finished mat and suspects that it may be unacceptable, follow these measures:

- a. Allow work to continue at Contractor's risk.
- b. Require Contractor to immediately and continually adjust operation until the visually apparent segregated areas are eliminated from the finished mat. The Department will immediately investigate to determine the severity of the apparent segregation as follows:
 - Take 6 in (150 mm) cores from typical areas of suspect segregation.
 - Test the cores for compliance with the mixture control tolerances in [Section 828](#).

When these tolerances are exceeded, suspend work for corrective action as outlined in [Subsection 400.3.06.E.3](#).

3. Corrective Work

- a. Remove and replace (at the Contractor's expense) any segregated area where the gradation on the control sieves is found to vary 10 percent or more from the approved job mix formula, the asphalt cement varies 1.0% or more from the approved job mix formula, or if in-place air voids exceed 13.5% based on [GDT 39](#). The control sieves for each mix type are shown in [Subsection 400.5.01.B "Determine Lot Acceptance."](#)
- b. Subsurface mixes. For subsurface mixes, limit removal and replacement to the full lane width and no less than 10 ft. (3 m) long and as approved by the Engineer.
- c. Surface Mixes. For surface mixes, ensure that removal and replacement is not less than the full width of the affected lane and no less than the length of the affected areas as determined by the Engineer.

Surface tolerance requirements apply to the corrected areas for both subsurface and surface mixes.

400.3.07 Contractor Warranty and Maintenance

A. Contractor's Record

Maintain a dated, written record of the most recent plant calibration. Keep this record available for the Engineer's inspection at all times. Maintain records in the form of:

- Graphs
- Tables
- Charts
- Mechanically prepared data

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400.4 Measurement

Thickness and spread rate tolerances for the various mixtures are specified in [Subsection 400.4.A.2.b, Table 11, Thickness and Spread Rate Tolerance at Any Given Location](#). These tolerances are applied as outlined below:

A. Hot Mix Asphaltic Concrete Paid for by Weight

1. Plans Designate a Spread Rate

- a. Thickness Determinations. Thickness determinations are not required when the Plans designate a spread rate per square yard (meter).

If the spread rate exceeds the upper limits outlined in the [Subsection 400.4.A.2.b, Table 11, “Thickness and Spread Rate Tolerance at Any Given Location”](#), the mix in excess will not be paid for.

If the rate of spread is less than the lower limit, correct the deficient course by overlaying the entire lot.

The mixture used for correcting deficient areas is paid for at the Contract Unit Price of the course being corrected and is subject to the [Mixture Acceptance Schedule—Table 9 or 10](#).

- b. Recalculate the Total Spread Rate. After the deficient hot mix course has been corrected, the total spread rate for that lot is recalculated, and mix in excess of the upper tolerance limit as outlined in the [Subsection 400.4.A.2.b, Table 11, “Thickness and Spread Rate Tolerance at Any Given Location”](#) is not paid for.

The quantity of material placed on irregular areas such as driveways, turnouts, intersections, feather edge section, etc., is deducted from the final spread determination for each lot.

2. Plans Designate Thickness

If the average thickness exceeds the tolerances specified in the [Subsection 400.4.A.2.b, Table 11, “Thickness and Spread Rate Tolerance at Any Given Location”](#), the Engineer shall take cores to determine the area of excess thickness. Excess quantity will not be paid for.

If the average thickness is deficient by more than the tolerances specified in the Thickness and Spread Rate Tolerance at Any Given Location table below, the Engineer shall take additional cores to determine the area of deficient thickness. Correct areas with thickness deficiencies as follows:

- a. Overlay the deficient area with the same mixture type being corrected or with an approved surface mixture. The overlay shall extend for a minimum of 300 ft (90 m) for the full width of the course.
- b. Ensure that the corrected surface course complies with [Subsection 400.3.06.C.1, “Visual and Straightedge Inspection.”](#) The mixture required to correct a deficient area is paid for at the Contract Unit Price of the course being corrected.

The mixture is subject to the [Mixture Acceptance Schedule—Table 9 or 10](#). The quantity of the additional mixture shall not exceed the required calculated quantity used to increase the average thickness of the overlaid section to the maximum tolerance allowed under the following table.

Table 11—Thickness and Spread Rate Tolerance at Any Given Location

Course	Thickness Specified	Spread Rate Specified
Asphaltic concrete base course	± 0.5 in (±13 mm)	+40 lbs, -50 lbs (+20 kg, -30 kg)
Intermediate and/or wearing course	± 0.25 in (± 6 mm)	+20 lbs, -25 lbs (+10 kg, -15 kg)
Overall of any combination of 1 and 2	± 0.5 in (±13 mm)	+40 lbs, -50 lbs (+20 kg, -30 kg)

Note 1: For asphaltic concrete 9.5 mm OGFC and 12.5 mm OGFC, control the spread rate per lot within 5 lbs/yd² (3 kg/m²) of the designated spread rate. For asphaltic concrete 12.5 mm PEM, control the spread rate per lot within 10 lbs/yd² (6 kg/m²) of the designated spread rate.

Note 2: Thickness and spread rate tolerances are provided to allow normal variations within a given lot. Do not continuously operate at a thickness of spread rate not specified.

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When the Plans specify a thickness, the Engineer may take as many cores as necessary to determine the average thickness of the intermediate or surface course. The Engineer shall take a minimum of one core per 1,000 ft (300 m) per two lanes of roadway. Thickness will be determined by average measurements of each core according to [GDT 42](#).

If the average exceeds the tolerances specified in the [Subsection 400.4.A.2.b, Table 11, “Thickness and Spread Rate Tolerance at Any Given Location”](#), additional cores will be taken to determine the area of excess thickness and excess tonnage will not be paid for.

B. Hot Mix Asphaltic Concrete Paid for by Square Yard (Meter)

1. The thickness of the base course or the intermediate or surface course will be determined by the Department by cutting cores and the thickness will be determined by averaging the measurements of each core.
2. If any measurement is deficient in thickness more than the tolerances given in the table above, additional cores will be taken by the Department to determine the area of thickness deficiency. Correct thickness deficiency areas as follows:
 - a. Overlay the deficient area with the same type mixtures being corrected or with surface mixture. Extend the overlay at least 300 ft (90 m) for the full width of the course.
 - b. Ensure that the corrected surface course complies with [Subsection 400.3.06.C.1, Visual and Straightedge Inspection](#).
 - c. The mixture is subject to the [Mixture Acceptance Schedule—Table 9 or 10](#).
3. No extra payment is made for mixtures used for correction.
4. No extra payment is made for thickness in excess of that specified.

NOTE: Thickness tolerances are provided to allow normal variations within a given lot. Do not continuously operate at a thickness not specified.

C. Asphaltic Concrete

Hot mix asphaltic concrete, complete in place and accepted, is measured in tons (megagrams) or square yards (meters) as indicated in the Proposal. If payment is by the ton (megagram), the actual weight is determined by weighing each loaded vehicle on the required motor truck scale as the material is hauled to the roadway, or by using recorded weights if a digital recording device is used.

The weight measured includes all materials. No deductions are made for the weight of the individual ingredients. The actual weight is the pay weight except when the aggregates used have a combined bulk specific gravity greater than 2.75. In this case the pay weight is determined according to the following formula:

$$T1 = T \times \left\{ \frac{\% AC + \left(\frac{\% Aggregate \times 2.75}{\text{combined bulk Specific Gravity}} \right) + \% Y}{100} \right\}$$

Where:

T1	Pay weight, tonnage (Mg)
T=	Actual weight
% AC=	Percent asphalt cement by weight of total mixture
% Aggregate =	Percent aggregate by weight of total mixture

Section 400—Hot Mix Asphaltic Concrete Construction

Combined Bulk Sp. Gr.=	Calculated combined bulk specific gravity of various mineral aggregates used in the mixture
% Y=	Percent hydrated lime by weight of mineral aggregate

D. Bituminous Material

Bituminous material is not measured for separate payment.

E. Hydrated Lime

When hydrated lime is used as an anti-stripping additive, it is not measured for separate payment.

F. Field Laboratory

The field laboratory required in this Specification is not measured for separate payment.

G. Asphaltic Concrete Leveling

Payment of hot mix asphaltic concrete leveling, regardless of the type mix, is full compensation for furnishing materials, bituminous materials, and hydrated lime (when required) for patching and repair of minor defects, surface preparation, cleaning, hauling, mixing, spreading, and rolling.

Mixture for leveling courses is subject to the acceptance schedule as stated in [Subsection 400.3.06.A](#) and [Subsection 400.3.06.B](#).

H. Asphaltic Concrete Patching

Hot mix asphaltic concrete patching, regardless of the type mix, is paid for at the Contract Unit Price per ton (Megagram), complete in place and accepted. Payment is full compensation for:

- Furnishing materials such as bituminous material and hydrated lime (when required)
- Preparing surface to be patched
- Cutting areas to be patched, trimmed, and cleaned
- Hauling, mixing, placing, and compacting the materials

400.4.01 Limits

When the asphaltic concrete is paid for by the square yard (meter) and multiple lifts are used, the number and thickness of the lifts are subject to the Engineer's approval and are used to prorate the pay factor for the affected roadway section.

400.5 Payment

When materials or construction are not within the tolerances in this Specification, the Contract Price will be adjusted according to [Subsection 106.03, "Samples, Tests, Cited Specifications"](#) and [Subsection 400.3.06, "Quality Acceptance."](#)

Hot mix asphaltic concrete of the various types are paid for at the Contract Unit Price per ton (megagram) or per square yard (meter). Payment is full compensation for furnishing and placing materials including asphalt cement, hydrated lime when required, approved additives, and for cleaning and repairing, preparing surfaces, hauling, mixing, spreading, rolling, and performing other operations to complete the Contract Item.

Payment will be made under:

Item No. 400	Asphaltic concrete <u>type</u> Suprpave, <u>group-blend</u> , Including polymer-modified bituminous materials and hydrated lime	Per ton (megagram)
Item No. 400	Asphaltic concrete <u>type</u> , Superpave, <u>group-blend</u> , including bituminous materials and hydrated lime	Per ton (megagram)
Item No. 400	Asphaltic concrete <u>type</u> Superpave, <u>group-blend</u> , Including bituminous materials, Gilsonite modifier, and hydrated lime	Per ton (megagram)

Item No. 400	_____ inches asphaltic concrete, <u>type</u> Superpave, <u>group-blend</u> including bituminous materials, Gilsonite modifier and hydrated lime	Per square yard (meter)
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Item No. 400	Asphaltic concrete <u>type</u> Stone Matrix Asphalt, <u>group-blend</u> , including polymer-modified bituminous materials and hydrated lime	Per ton (megagram)
Item No. 400	Asphaltic concrete <u>type</u> OGFC, <u>group 2</u> only, including bituminous materials and hydrated lime	Per ton (megagram)
Item No. 400	Asphaltic concrete <u>type</u> OGFC, <u>group 2</u> only, including polymer-modified bituminous materials and hydrated lime	Per ton (megagram)
Item No. 400	Asphaltic concrete <u>type</u> Porous European Mix, <u>group 2</u> only, including polymer-modified bituminous materials and hydrated lime	Per ton (megagram)

400.5.01 Adjustments

A. Materials Produced and Placed During the Adjustment Period

An adjustment period is allowed at the start of mixing operations for each type of mix placed on the Contract except for Asphaltic Concrete OGFC or PEM. The adjustment period is provided to adjust or correct the mix and to establish the construction procedures and sequence of operations.

The adjustment period consists of the tons (megagrams) of the affected mix produced and placed on the first day of operation. If this quantity is less than 500 tons (500 Mg), the Engineer may combine the tons (megagrams) produced and placed on the first day of operation with the tons (megagrams) produced and placed on the next production day of the affected mix for the adjustment period.

The material produced and placed during the mixture adjustment period is one lot. If the mix is adjusted during this period, a new lot may be necessary, but a new adjustment period will not be permitted.

This material shall be paid for at 100 percent of the Contract Unit Price provided it meets the minimum requirements for a 1.00 pay factor for asphalt cement content and a 0.90 pay factor for gradation in the [Mixture Acceptance Schedule—Table 9 or 10](#).

If the material placed during the adjustment period fails to meet the above requirements, it will be paid for using the applicable acceptance schedule. However, when mixture used for leveling at a spread rate of 90 lbs/yd² (50 kg/m²) or less is also used for the surface mix at a spread rate greater than 90 lbs/yd² (50 kg/m²), an additional adjustment period will be allowed for compaction only. This material will be paid for at a 1.00 pay factor provided it:

- Meets the minimum requirements for a 1.00 pay factor in the Mixture Acceptance Schedule—Table 9 or 10 for both asphalt content and gradation.
- Meets the minimum requirements for a 0.90 pay factor in Table 12 of [Subsection 400.5.01C, “Calculate Mean Pavement Air Voids.”](#)

Mixture which does not meet these requirements shall be paid for using the applicable acceptance schedule.

B. Determine Lot Acceptance

Pay factor adjustments are based on control sieves and asphalt cement content. The control sieves used in the mixture acceptance schedule for the various types of mix are indicated below:

Control Sieves Used in the Mixture Acceptance Schedule	
Asphaltic concrete 25 mm Superpave	1/2 in., No. 8 (12.5 mm, 2.36 mm) sieves and asphalt cement
Asphaltic concrete 19 mm SMA	1/2 in., No. 8 (12.5 mm, 2.36 mm) sieves and asphalt cement
Asphaltic concrete 19 mm Superpave	3/8 in., No. 8 (9.5 mm, 2.36 mm) sieves and asphalt cement
Asphaltic concrete 12.5 mm Superpave	3/8 in., No. 8 (9.5 mm, 2.36 mm) sieves and asphalt cement
Asphaltic concrete 12.5 mm SMA	3/8 in., No. 8 (9.5 mm, 2.36 mm) sieves and asphalt cement
Asphaltic concrete 12.5 mm PEM	3/8 in., No. 8 (9.5 mm, 2.36 mm) sieves and asphalt cement
Asphaltic concrete 12.5 mm OGFC	3/8 in., No. 8 (9.5 mm, 2.36 mm) sieves and asphalt cement
Asphaltic concrete 9.5 mm Superpave	No. 4, No. 8 (4.75 mm, 2.36 mm) sieves and asphalt cement

Section 400—Hot Mix Asphaltic Concrete Construction

Control Sieves Used in the Mixture Acceptance Schedule	
Asphaltic concrete 9.5 mm SMA	No. 4, No. 8 (4.75 mm, 2.36 mm) sieves and asphalt cement
Asphaltic concrete 9.5 mm OGFC	No. 4, No. 8 (4.75 mm, 2.36 mm) sieves and asphalt cement
Asphaltic concrete 4.75 mm Mix	No. 8 (2.36 mm) sieve and asphalt cement

For projects which do not have milling quantities established as a Pay Item, the Department will pay for 12.5 mm OGFC and PEM placed on ramps and end of project transitions under the appropriate mixture pay item, but the mix shall be subject to the same gradation and control sieve requirements as asphaltic concrete 9.5 mm OGFC. Add polymer-modified bituminous material, hydrated lime, and stabilizing fiber to this mix.

The Department will perform the following tasks:

1. Using the [Mixture Acceptance Schedule—Table 9 or 10](#), determine the mean of the deviations from the job mix formula per test results per lot.
2. Determine this mean by averaging the actual numeric value of the individual deviations from the job mix formula; disregard whether the deviations are positive or negative amounts.
3. Use the Asphalt Cement Content and Aggregate Gradation of Asphalt Concrete [Mixture Acceptance Schedule—Table 9](#) to determine acceptance of surface mixes and the [Mixture Acceptance Schedule—Table 10](#) to determine acceptance of subsurface mixes.

On Contracts involving 1,000 tons (1000 Mg) or less of asphaltic concrete, the mixture is accepted for 100 percent payment of the asphaltic concrete Unit Price provided it meets the following:

1. Minimum requirements for a 1.00 pay factor for asphalt cement content and a 0.90 pay factor for gradation in the applicable [Mixture Acceptance Schedule—Table 9 or 10](#).
2. Minimum requirements for a 0.90 pay factor in Table 12 of [Subsection 400.5.01C, “Calculate Pavement Mean Air Voids](#).

If the material placed on Contracts involving 1,000 tons (1000 Mg) or less of asphaltic concrete does not meet the above requirements, the material will be paid for using the applicable acceptance schedule.

C. Calculate Pavement Mean Air Voids

The Department will determine the percent of maximum air voids for each lot by dividing the pavement mean air voids by the maximum pavement mean air voids acceptable.

The Department will determine the payment for each lot by multiplying the Contract Unit Price by the adjusted pay factor shown in the following Air Voids Acceptance schedule:

Table 12 - Air Voids Acceptance Schedule

Pay Factor	Percent of Maximum Air Voids (Lot Average of Tests)	Percent of Maximum Air Voids (Lot Average all Tests) (for Reevaluations)
1.00	≤100	≤100
0.97	100.1 — 105	100.1 — 104
0.95	105.1 — 112	104.1 — 109
0.90	112.1 — 124	109.1 — 118
0.80	124.1 — 149	118.1 — 136
0.70	149.1 — 172	136.1 — 153
0.50	172.1 — 191	153.1 — 166

When the range tolerance is exceeded, the Department will apply a pay factor of 0.95 as described in [Subsection 400.3.06.B.2](#).

Section 400—Hot Mix Asphaltic Concrete Construction

D. Asphaltic Concrete For Temporary Detours

Hot mix asphaltic concrete placed on temporary detours that will not remain in place as part of the permanent pavement does not require hydrated lime. Hot mix used for this purpose is paid for at an adjusted Contract Price.

Where the Contract Price of the asphaltic concrete for permanent pavement is let by the ton (megagram), the Contract Price for the asphaltic concrete placed on temporary detours is adjusted by subtracting \$0.75/ton (\$0.85/mg) of mix used.

Where the Contract price of the mix in the permanent pavement is based on the square yard (meter), obtain the adjusted price for the same mix used on the temporary detour by subtracting \$0.04/yd² (\$0.05/ m²) per 1-in (25-mm) plan depth.

Further price adjustments required in [Subsection 400.3.06, “Quality Acceptance.”](#) are based on the appropriate adjusted Contract Price for mix used in the temporary detour work.

E. Determine Lot Payment

Determine the lot payment as follows:

1. When one of the pay factors for a specific acceptance lot is less than 1.0, determine the payment for the lot by multiplying the Contract Unit Price by the adjusted pay factor.
2. When two or more pay factors for a specific acceptance lot are less than 1.0, determine the adjusted payment by multiplying the Contract Unit Price by the lowest pay factor.

If the mean of the deviations from the job mix formula of the tests for a sieve or asphalt cement content exceeds the tolerances established in the [Mixture Acceptance Schedule—Table 9 or 10](#) and if the Engineer determines that the material need not be removed and replaced, the lot may be accepted at an adjusted unit price as determined by the Engineer. If the pavement mean air voids exceed the tolerances established in the [Air Voids Acceptance Schedule – Table 12](#), remove and replace the materials at the Contractor’s expense.

If the Engineer determines that the material is not acceptable to leave in place, remove and replace the materials at the Contractor’s expense.

DEPARTMENT OF TRANSPORTATION

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SPECIAL PROVISION

Section 400—Hot Mix Asphaltic Concrete Construction

Retain Special Provision Section 400.3.02 B and Add the following:

9. Crumb Rubber Modifier Supply System

Crumb rubber modifier may be substituted at the Contractor's discretion to produce a PG 76-22 asphaltic cement at the production facility:

- a. Use a separate feed system to store and proportion by weight of the total asphaltic cement, the required percentage of crumb rubber into the mixture.
- b. Control the feeder system with a proportioning device meeting these Specifications:
 - Is accurate to within ± 5 percent of the amount required. Automatically adjusts the feed rate to maintain the material within this tolerance at all times.
 - Has a convenient and accurate means of calibration.
 - Provide in-process monitoring, consisting of either a digital display of output or a printout of feed rate, in pounds per minute, to verify feed rate. The supply system shall report the feed in 1 lb increments using load cells that will enable the user to monitor the depletion of the modifier. Monitoring the system volumetrically will not be allowed.
 - Interlocks with the aggregate weigh system and asphaltic cement pump to maintain the correct proportions for all rates of production and batch sizes.
- c. Provide flow indicators or sensing devices for the system and interlock them with the plant controls to interrupt the mixture production if the crumb rubber introduction output rate is not within the ± 5 percent tolerance given above. This interlock will immediately notify the operator if the targeted rate exceeds introduction tolerances. All plant production will cease if the incorporation rate is not brought back within tolerance after 30 seconds. When the interlock system interrupts production and the plant has to be restarted, upon restarting operations; the modifier system shall run until a uniform feed can be observed on the output display. All mix produced prior to this point shall be rejected.
- d. Introduce the crumb rubber modifier as follows:
 - When a batch type plant is used, add the rubber to the aggregate in the weigh hopper. Increase the batch dry mixing time by 15 to 20 seconds from the time the aggregate is completely emptied into the mixer to ensure the modifiers are uniformly distributed prior to the injection of asphalt cement into the mixer. Increase the batch wet mix time by 15 to 20 seconds to ensure the crumb rubber modifier is uniformly blended with the asphaltic cement.

- When a continuous or drier-drum type plant is used, add the rubber to the aggregate and uniformly disperse prior to the injection of asphalt cement. The point of introduction in the drum mixer will be approved by the Engineer prior to production. Ensure the crumb rubber modifier will not become entrained in the exhaust system of the drier or plant and will not be exposed to the drier flame at any point after induction.
- e. No separate measurement and payment will be made if Contractor elects to utilize crumb rubber.

GEORGIA DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA
SUPPLEMENTAL SPECIFICATION

Section 402—Hot Mix Recycled Asphaltic Concrete

Delete Section 402 and substitute the following:

402.1 General Description

This work includes producing and placing hot mix recycled asphaltic concrete that incorporates reclaimed asphalt pavement (RAP), reclaimed asphalt shingles (RAS), virgin aggregate, hydrated lime, and neat asphalt cement.

402.1.01 Definitions

General Provisions 101 through 150.

402.1.02 Related References

A. Standard Specifications

[Section 400—Hot Mix Asphaltic Concrete Construction](#)

[Section 800—Coarse Aggregate](#)

[Section 828—Hot Mix Asphaltic Concrete Mixtures](#)

B. Referenced Documents

SOP 41 “Guidelines for RAP Stockpile Approval”

402.1.03 Submittals

A. Certified Weight Tickets

Notify the Engineer before removing RAP from a stockpile that belongs to the Department. Submit to the Engineer the certified weight tickets of materials removed from the stockpile.

B. Affidavit

Submit to the laboratory an affidavit stating the sources of stockpiled materials to be used on a State project. Include the following information in the letter:

- State project number
- Location from which the material was removed
- Approximate removal dates
- Mix types removed and the estimated quantity of each type in the stockpiles
- Other available information about the stockpiled material such as percentage of local sand in the RAP

Obtain specific approval from the laboratory to use RAP or RAS stockpiles.

Adhere to Guidelines for RAP Stockpile Approval.

402.2 Materials

A. RAP Material Composition

Use RAP materials from any of the following:

- Existing roadway
- Contractor's RAP stockpile that has been approved by the Department
- Department stockpile

NOTE: The location of Department RAP material stockpiles will be given on the Plans.

Do not use RAP materials that contain alluvial gravel or local sand in any mixture placed on interstate projects except for mixtures used in shoulder construction. When used in shoulder construction, limit RAP containing local sand or alluvial gravel so that the sand or gravel contributes no more than 20% of the total aggregate portion of the mix.

1. RAP Percentage

For non-interstate projects, limit the percentage of RAP allowed in recycled mixes so that the overall amount of alluvial gravel does not exceed 5 percent of the total mix. The percentage of alluvial gravel, local sand, and Group I material in the RAP will be determined through petrographic analysis or available records.

RAP furnished to the Contractor but not used in the work remains the Contractor's property.

RAP used in the recycled mixtures for mainline or ramps (if applicable) may make up from 0 to 40 percent of the mixture depending on the amount of RAP available, the production facilities, and whether the mixture meets the requirements in [Section 828](#).

The maximum ratio of RAP material to the recycled mixtures other than SMA is 40 percent for continuous mix type plants and 25 percent for batch type plants. The maximum ratio of RAP material to the recycled mixture is 15 percent for Stone Matrix Asphalt (SMA) mixes.

2. Process RAP Material

Process RAP material to be used in the recycled mixture so that 100 percent will pass the 2 in (50 mm) sieve.

Additional crushing and sizing may be required if the RAP aggregate exceeds the maximum sieve size for the mix type as shown in [Section 828](#). Obtain representative materials from the RAP stockpile for the mix design.

B. RAS Material

RAS materials are produced as a by-product of manufacturing roofing shingles and/or discarded shingle scrap from the reroofing of buildings.

1. Limit the amount of RAS material used in the recycled mixture to no greater than 5 percent of the total mixture weight.
2. Shred the RAS material before incorporating it into the mix to ensure that 100 percent of the shredded pieces are less than 1/2 in (12.5 mm) in any dimension.
3. Remove all foreign materials such as paper, roofing nails, wood, or metal flashing.
4. Provide test results for Bulk Sample Analysis, known as Polarized Light Microscopy, if post-consumer shingles are used to certify the RAS material is free of asbestos. Test stockpiles at the rate of one test per 1000 tons (megagrams) prior to processing.

Other than as specifically stated in this Subsection, ensure that RAS material is used according to the same requirements as described for RAP material.

C. Asphaltic Concrete Removed from an Existing Roadway

Asphaltic concrete removed from an existing roadway becomes the Contractor's property unless specified otherwise on the Plans. RAP material retained by the Department is designated on the Plans, and the RAP shall be stockpiled at the location specified on the Plans.

D. Local Sand and Group I Material in RAP

Use of local sand in recycled mixes is restricted as stipulated in [Section 828](#) for the Project. However, RAP which contains local sand may be used in surface and intermediate layers of non-interstate projects so long as the RAP percentage used does not contribute more than 5% local sand to the total aggregate portion of the mix. The amount of local sand in the RAP material shall be considered when determining the percentage of local sand in the total mix.

Where Pay Items specify that Group II only aggregate is to be used, RAP which consists primarily of Group II aggregate, but contains some Group I aggregate, shall be limited such that the Group I aggregate makes up no more than 5% of the total aggregate portion of the mix. When a Blend I mix is specified, any Group I materials in the RAP will be considered when determining the Group I portion allowed in the total mix as specified in [Subsection 828.2.A.2](#).

E. Asphalt Cement

Using laboratory evaluations, the Department will determine the asphalt cement grade to be used in the recycled mixture. The asphalt cement shall meet the requirements of [Section 820](#).

When the asphalt cement is blended with asphalt cement recovered from the RAP material and after tests on residue from thin film oven tests, the asphalt cement shall have a viscosity of 6,000 to 16,000 poises (600 to 1600 Pa) or as approved by the Engineer. Recover asphalt cement from the recycled mixture to verify that the specified viscosity is being met.

If the Engineer determines during construction that the selected asphalt cement grade is not performing satisfactorily, the Department may change the asphalt cement grade in the mixture, with no change in the Contract Unit Price.

F. Recycled Mixture

The recycled mixture shall be a homogenous mixture of RAP or RAS material, virgin aggregate, hydrated lime, and neat asphalt cement. Ensure that the mixture conforms to an approved mixture design outlined in [Section 828](#).

402.2.01 Delivery, Storage, and Handling

Separate the stockpiles by Project sources and by Group I and Group II aggregate types. Erect a sign on each stockpile to identify the source(s).

If RAP material from different project sources becomes intermixed in a stockpile, only use those materials when approved by the laboratory.

The Department may reject by visual inspection stockpiles that are not clean and free of foreign materials.

402.3 Construction Requirements

402.3.01 Personnel

General Provisions 101 through 150.

402.3.02 Equipment

A. Hot Mix Plant

Use a hot mix plant for the recycling process with necessary modifications approved by the Engineer to process recycled material. Design, equip, and operate the plant so that the proportioning, heating, and mixing yields a uniform final mixture within the job mix formula tolerances.

B. Cold Feed Bin

Proportion the RAP or RAS material using a separate cold feed bin. Ensure that the material meets the size requirements in [Subsection 402.2, "Materials."](#) The ratio of the RAP or RAS to virgin aggregate shall be controlled gravimetrically.

C. Electronic Belt Weighing Devices

Use electronic belt weighing devices to monitor the flow of RAP or RAS and the flow of virgin aggregate. For batch-type plants, the RAP or RAS portion of the mix may be weighed in a weigh hopper before incorporating it into the pugmill. The RAP shall be screened through a 2-inch maximum sized screen prior to crossing the cold feed weigh.

Ensure the amount of RAP material incorporated into the asphalt plant does not change after this final measurement is processed by the asphalt plant computer.

D. Feeders and Conveyors

Equip plants with an interlocking system of feeders and conveyors that synchronize the RAP or RAS material flow with the virgin aggregate flow. Ensure that the electronic controls track the flow rates indicated by the belt weighing devices and develop the signal to automatically maintain the desired ratio at varying production rates. Design the RAP or RAS feeder bins, conveyor system, and auxiliary bins (if used) to prevent RAP material from segregating and sticking.

402.3.03 Preparation

General Provisions 101 through 150.

402.3.04 Fabrication

General Provisions 101 through 150.

402.3.05 Construction

Follow the requirements in Section 400 for hot mix recycled asphaltic concrete production and placement, materials, equipment, and acceptance plans except as noted or modified in this Specification.

402.3.06 Quality Acceptance

The Department may require additional quality control tests to determine the RAP stockpile consistency and the RAP aggregate quality. In this case, conduct at least three extraction/gradation tests from each individual source. Ensure that aggregate meets the quality standards in [Section 800](#).

402.3.07 Contractor Warranty and Maintenance

General Provisions 101 through 150.

402.4 Measurement

Recycled asphaltic concrete mixture, complete in place and accepted, is measured in tons (megagrams). The weight is determined by recorded weights if an approved recording device is used. Or, the weight is determined by weighing each loaded vehicle on an approved motor truck scale as the material is hauled to the roadway.

402.4.01 Limits

General Provisions 101 through 150.

402.5 Payment

The work performed and the materials furnished as described in this Specification will be paid for at the Contract Unit Price per ton (megagram). Payment is full compensation for providing materials, hauling and necessary crushing, processing, placing, rolling and finishing the recycled mixture, and providing labor, tools, equipment, and incidentals necessary to complete the work, including hauling and stockpiling RAP or RAS material.

Payment will be made under:

Item No. 402	Recycled asphaltic concrete ___ mm Superpave, group-blend, including bituminous materials	Per ton (megagram)
Item No. 402	Recycled asphaltic concrete ___ mm Superpave, group-blend, including bituminous materials and hydrated lime	Per ton (megagram)
Item No. 402	Recycled asphaltic concrete ___ mm Superpave, group-blend, including polymer-modified bituminous materials and hydrated lime	Per ton (megagram)
Item No. 402	Recycled asphaltic concrete ___ mm Superpave, Type ___, group-blend, including bituminous materials and hydrated lime	Per ton (megagram)
Item No.	Recycled asphaltic concrete _____ mm mix, group-blend,	Per ton (megagram)

402	including bituminous materials and hydrated lime	
Item No. 402	_____ in (mm) recycled asphaltic concrete <u>type</u> Superpave, group-blend, including bituminous materials	Per square yard (meter)
Item No. 402	_____ in (mm) recycled asphaltic concrete <u>type</u> Superpave, group-blend, including bituminous materials and hydrated lime	Per square yard (meter)
Item No. 402	_____ in (mm) recycled asphaltic concrete <u>type</u> Superpave, group-blend, including polymer-modified bituminous materials and hydrated lime	Per square yard (meter)
Item No. 402	_____ in (mm) recycled asphaltic concrete _____ mm mix, group-blend, including bituminous materials and hydrated lime	Per square yard (meter)
Item No. 402	Recycled asphaltic concrete patching including bituminous materials	Per ton (megagram)
Item No. 402	Recycled asphaltic concrete patching including bituminous materials and hydrated lime	Per ton (megagram)
Item No. 402	Recycled asphaltic concrete leveling including bituminous materials	Per ton (megagram)
Item No. 402	Recycled asphaltic concrete leveling including bituminous materials and hydrated lime	Per ton (megagram)
Item No. 402	Recycled asphaltic concrete type Stone Matrix Asphalt, group-blend, including polymer-modified bituminous materials and hydrated lime	Per ton (megagram)

A. Materials Produced and Placed During the Adjustment Period

An adjustment period is allowed at the start of mixing operations for each type of mix placed on the Contract. A new adjustment period shall not be granted for a change of producer, mix design or asphalt plant location. The adjustment period is provided to adjust or correct the mix and to establish the construction procedures and sequence of operations.

The adjustment period consists of the tons (megagrams) of the affected mix produced and placed on the first day of operation. If this quantity is less than 500 tons (500 Mg), the Engineer may combine the tons (megagrams) produced and placed on the first day of operation with the tons (megagrams) produced and placed on the next production day of the affected mix for the adjustment period.

The material produced and placed during the mixture adjustment period is one lot. If the mix is adjusted during this period, a new lot may be necessary, but a new adjustment period will not be permitted.

This material shall be paid for at 100 percent of the Contract Unit Price provided it meets the minimum requirements for a 1.00 pay factor for asphalt cement content and a 0.90 pay factor for gradation in the [Mixture Acceptance Schedule—Table 9 or 10](#).

If the material placed during the adjustment period fails to meet the above requirements, it will be paid for using the applicable acceptance schedule. However, when mixture used for leveling at a spread rate of 90 lbs/yd² (50 kg/m²) or less is also used for the surface mix at a spread rate greater than 90 lbs/yd² (50 kg/m²), an additional adjustment period will be allowed for compaction only. This material will be paid for at a 1.00 pay factor provided it:

- Meets the minimum requirements for a 1.00 pay factor in the Mixture Acceptance Schedule—Table 9 or 10 for both asphalt content and gradation.
- Meets the minimum requirements for a 0.90 pay factor in Table 12 of [Subsection 400.5.01C, “Calculate Mean Pavement Air Voids.”](#)

Mixture which does not meet these requirements shall be paid for using the applicable acceptance schedule.

B. Determine Lot Acceptance

Pay factor adjustments are based on control sieves and asphalt cement content. The control sieves used in the mixture acceptance schedule for the various types of mix are indicated below:

Control Sieves Used in the Mixture Acceptance Schedule	
Asphaltic concrete 25 mm Superpave	1/2 in., No. 8 (12.5 mm, 2.36 mm) sieves and asphalt cement
Asphaltic concrete 19 mm Superpave	3/8 in., No. 8 (9.5 mm, 2.36 mm) sieves and asphalt cement
Asphaltic concrete 12.5 mm Superpave	3/8 in., No. 8 (9.5 mm, 2.36 mm) sieves and asphalt cement
Asphaltic concrete 9.5 mm Superpave	No. 4, No. 8 (4.75 mm, 2.36 mm) sieves and asphalt cement
Asphaltic concrete 4.75 mm Mix	No. 8 (2.36 mm) sieve and asphalt cement

The Department will perform the following tasks:

5. Using the [Mixture Acceptance Schedule—Table 9 or 10](#), of [Subsection 400.3.06](#) to determine the mean of the deviations from the job mix formula per test results per lot.
2. Determine this mean by averaging the actual numeric value of the individual deviations from the job mix formula; disregard whether the deviations are positive or negative amounts.
3. Use the Asphalt Cement Content and Aggregate Gradation of Asphalt Concrete [Mixture Acceptance Schedule—Table 9](#) of [Subsection 400.3.06](#) to determine acceptance of surface mixes and the [Mixture Acceptance Schedule—Table 10](#) of [Subsection 400.3.06](#) to determine acceptance of subsurface mixes.

On Contracts involving 1,000 tons (1000 Mg) or less of asphaltic concrete, the mixture is accepted for 100 percent payment of the asphaltic concrete Unit Price provided it meets the following:

6. Minimum requirements for a 1.00 pay factor for asphalt cement content and a 0.90 pay factor for gradation in the applicable [Mixture Acceptance Schedule—Table 9 or 10](#) of [Subsection 400.3.06](#).
7. Minimum requirements for a 0.90 pay factor in [Table 12 of Subsection 402.5.01.C, “Calculate Pavement Mean Air Voids.](#)

If the material placed on Contracts involving 1,000 tons (1000 Mg) or less of asphaltic concrete does not meet the above requirements, the material will be paid for using the applicable acceptance schedule.

C. Calculate Pavement Mean Air Voids

The Department will determine the percent of maximum air voids for each lot by dividing the pavement mean air voids by the maximum pavement mean air voids acceptable.

The Department will determine the payment for each lot by multiplying the Contract Unit Price by the adjusted pay factor shown in the following Air Voids Acceptance schedule:

Table 12 - Air Voids Acceptance Schedule

Pay Factor	Percent of Maximum Air Voids (Lot Average of Tests)	Percent of Maximum Air Voids (Lot Average all Tests) (for Reevaluations)
1.00	≤100	≤100
0.97	100.1 — 105	100.1 — 104
0.95	105.1 — 112	104.1 — 109
0.90	112.1 — 124	109.1 — 118
0.80	124.1 — 149	118.1 — 136
0.70	149.1 — 172	136.1 — 153
0.50	172.1 — 191	153.1 — 166

When the range tolerance is exceeded, the Department will apply a pay factor of 0.95 as described in [Subsection 400.3.06.B.2.](#)

D. Asphaltic Concrete For Temporary Detours

Hot mix asphaltic concrete placed on temporary detours that will not remain in place as part of the permanent pavement does not require hydrated lime. Hot mix used for this purpose is paid for at an adjusted Contract Price. The payment for this item shall cover all cost of construction, maintenance and removal of all temporary mix. Hot mix asphaltic concrete placed as temporary mix shall meet requirements established in Subsection 400.3.05.F.

Where the Contract Price of the asphaltic concrete for permanent pavement is let by the ton (megagram), the Contract Price for the asphaltic concrete placed on temporary detours is adjusted by subtracting \$0.75/ton (\$0.85/mg) of mix used.

Where the Contract price of the mix in the permanent pavement is based on the square yard (meter), obtain the adjusted price for the same mix used on the temporary detour by subtracting \$0.04/yd² (\$0.05/ m²) per 1-in (25-mm) plan depth.

Further price adjustments required in [Subsection 400.3.06, "Quality Acceptance."](#) which are based on the appropriate adjusted Contract Price for mix used in the temporary detour work shall apply should temporary mix be left in place. Hot mix asphalt produced as temporary mix containing no hydrated lime shall be removed and replaced with permanent mix containing hydrated lime.

E. Determine Lot Payment

Determine the lot payment as follows:

8. When one of the pay factors for a specific acceptance lot is less than 1.0, determine the payment for the lot by multiplying the Contract Unit Price by the adjusted pay factor.
2. When two or more pay factors for a specific acceptance lot are less than 1.0, determine the adjusted payment by multiplying the Contract Unit Price by the lowest pay factor.

If the mean of the deviations from the job mix formula of the tests for a sieve or asphalt cement content exceeds the tolerances established in the [Mixture Acceptance Schedule—Table 9 or 10](#) and if the Engineer determines that the material need not be removed and replaced, the lot may be accepted at an adjusted unit price as determined by the Engineer. If the pavement mean air voids exceed the tolerances established in the [Air Voids Acceptance Schedule – Table 12](#), remove and replace the materials at the Contractor's expense.

If the Engineer determines that the material is not acceptable to leave in place, remove and replace the materials at the Contractor's expense.

DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA
SUPPLEMENTAL SPECIFICATION
Section 412—Bituminous Prime

Delete Section 412 and substitute the following:

412.1 General Description

This work includes preparing and treating an existing surface with bituminous material and blotter material, if required. Treat the surface according to these Specifications and conform to the lines shown on the Plans or established by the Engineer.

412.1.01 Definitions

General Provisions 101 through 150.

412.1.02 Related References

A. Standard Specifications

[Section 424—Bituminous Surface Treatment](#)

[Section 821—Cutback Asphalt](#)

B. Referenced Documents

General Provisions 101 through 150.

412.1.03 Submittals

General Provisions 101 through 150.

412.2 Materials

Unless otherwise specified, select the types of bituminous materials. The Engineer will determine the grade of materials to be used. The Specifications for the bituminous materials include:

Material	Section
Cutback Asphalt, RC-30, RC-70, RC-250 or MC-250, MC-30, or MC-70	821.2.01
Blotter Material (Sand)	412.3.05.G.3

412.2.01 Delivery, Storage, and Handling

General Provisions 101 through 150.

412.3 Construction Requirements

412.3.01 Personnel

General Provisions 101 through 150.

412.3.02 Equipment

Provide equipment that is in good repair, including at least the following units that meet the requirements of [Subsection 424.3.02, “Equipment.”](#)

- Pressure distributor
- Power broom and blower
- Aggregate spreader (if required)
- Pneumatic-tired roller

412.3.03 Preparation

See [Subsection 412.3.05.B, “Condition of Surface.”](#)

412.3.04 Fabrication

General Provisions 101 through 150.

412.3.05 Construction

Prime the following bases and other areas:

- Cement or lime stabilized bases or sub-bases, regardless of pavement thickness
- Soil or aggregate bases or sub-bases on which bituminous surface treatment will be placed
- Soil or aggregate bases or sub-bases on which less than 5 in (125 mm) total thickness of hot mix asphaltic concrete will be placed

Prime is not required on driveway construction and paved shoulders.

A. Weather Limitations

Do not apply bituminous prime under any of these conditions:

- Surface is wet.
- Air temperature is below 40 °F (4 °C) in the shade.
- Rain is imminent.
- Weather conditions may prevent proper prime coat construction.

B. Condition of Surface

Ensure that the surface to which the prime is to be applied has been finished to the line, grade, and cross section specified.

Ensure that the surface is uniformly compacted and bonded. Correct surface irregularities according to the Specifications for the construction being primed.

C. Cleaning

Remove from the road loose material, dust, caked clay, and other material that may prevent bonding of the prime with the surface. Use power sweepers or blowers the full width of the prime and 2 ft (600 mm) more on each side. Where necessary, sweep by hand.

D. Moisture

Ensure that the surface is only slightly damp. If the surface is too wet, allow it to dry. If it is too dry, the Engineer may require that it be sprinkled lightly just before priming.

E. Temperature and Surface Texture

The surface texture and condition of the surface determine the bituminous material grades to be used.

The following table shows the bituminous material grades and application temperatures as they are applied to various surface textures.

Base Texture	Tight	Average	Open
Materials and grade	MC-30	RC-70 or MC-70	RC-250 or MC-250

	RC-30		
Application temperature °F (°C)	80–120 (27–49)	105–180 (41–82)	145–220 (63–104)

The Engineer will determine the temperature for applying bituminous prime within the limits shown above.

Heat and apply bituminous materials as specified in [Subsection 424.3.05.D, “Heating Bituminous Material”](#) and [Subsection 424.3.05.E, “Applying Bituminous Material.”](#)

F. Amount and Extent of Prime

The Engineer will determine the exact amount of bituminous material to be used within minimum and maximum rates of 0.15 to 0.30 gal/yd² (0.7 to 1.4 liters/m²). Apply the specified amount as follows:

1. Apply the determined amount uniformly and accurately. Ensure that the amount applied to any 0.5-mile (800 m) section is within 5 percent of the amount specified.
2. Apply the prime the full width of the proposed wearing surface that will be superimposed plus 6 in (150 mm) more on each side.

G. Protection, Curing, and Maintenance

Do the following after priming the surface:

1. Close to Traffic
Do not allow traffic on the primed surface. Leave the surface undisturbed until the prime thoroughly cures and does not pick up under traffic.
2. Roll
If the surface becomes soft after it is primed, roll the surface longitudinally with a pneumatic-tired roller at no more than 6 mph (10 kph) until the surface is firmly set.
3. Blot
If necessary to prevent the prime from being picked up, spread clean, dry, sharp sand over the surface by hand or mechanically. Apply sand only to places that are tacky and use the least amount needed to prevent pick up. No extra payment for this work or material will be made.
4. Open to Traffic
After rolling and sanding (if required), open the primed surface to ordinary traffic subject to the conditions in [Subsection 412.3.05.G.1, “Close to Traffic.”](#)
5. Curing and Maintenance
The primed surface is properly cured when it has penetrated the base sufficiently to not be picked up or displaced by traffic. Temperature and weather conditions may increase curing time. Insure the primed surface has cured to the satisfaction of the Engineer prior to its being covered by other construction.
Maintain the prime coat and the primed surface course until it is covered by other construction. Repair potholes, scabs, and soft spots prior to covering with other construction. Remove excess bituminous material.

412.3.06 Quality Acceptance

General Provisions 101 through 150.

412.3.07 Contractor Warranty and Maintenance

General Provisions 101 through 150.

412.4 Measurement

Bituminous material for prime is not measured for separate payment.

412.4.01 Limits

General Provisions 101 through 150.

412.5 Payment

Bituminous material for prime is not paid for separately. The cost to clean the surface, furnish, haul and apply materials including water and sand, roll, and perform repairs and maintenance is included in the Unit Price bid for each individual Base Item.

412.5.01 Adjustments

General Provisions 101 through 150.

Office of Materials and Research

Revised November 21, 2006
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Revised: February 16, 2011

Department of Transportation
State of Georgia
Special Provision

Section 413—Bituminous Tack Coat

Delete Section 413 and substitute the following:

413.1 General Description

This work includes furnishing and applying a bituminous tack coat on a prepared road surface including cleaning the road surface.

413.1.01 Definitions

General Provisions 101 through 150.

413.1.02 Related References

A. Standard Specifications

[Section 109—Measurement and Payment](#)

[Section 400—Hot Mix Asphaltic Concrete Construction](#)

[Section 424—Bituminous Surface Treatment](#)

[Section 427—Emulsified Asphalt Slurry Seal](#)

[Section 820—Asphalt Cement](#)

[Section 822 – Emulsified Asphalt](#)

[Section 824—Cationic Asphalt Emulsion](#)

B. Referenced Documents

General Provisions 101 through 150.

413.1.03 Submittals

General Provisions 101 through 150.

413.2 Materials

Ensure materials meet the following Specifications:

Material	Section
Asphalt cement, performance grade PG 58-22, PG 64-22, or PG 67-22	820.2.01
Anionic emulsion asphalt NTSS-1HM	822.2.01
Cationic emulsified asphalt CRS-2h or CRS-3	824.2.01

Asphalt cement of performance grade PG 58-22, PG 64-22 or PG 67-22 is used for bituminous tack coat in work performed in [Section 400](#). Use anionic emulsified asphalt as an option with the approval of the Engineer. Use cationic emulsified asphalt as a special application material only if directed by the Engineer.

The Department may change the grade or type of bituminous materials without a change in the Contract Unit Price if the Engineer determines the grade or type selected is not performing satisfactorily.

413.2.01 Delivery, Storage, and Handling

General Provisions 101 through 150.

Emulsified Asphalt

Maintain all equipment used for the delivery, storage, and handling of anionic emulsified asphalt or cationic emulsified asphalt to prevent contamination of the emulsion. Transfer anionic emulsified asphalt or cationic emulsified asphalt directly to the pressure distributor from the transport tanker.

Provide and maintain temperature measuring devices to continuously monitor the temperature of anionic emulsified asphalt or cationic emulsified asphalt in storage and in the pressure distributor. Do not allow anionic emulsified asphalt or cationic emulsified asphalt to freeze.

Note 1: Do not store anionic emulsified asphalt or cationic emulsified asphalt for a period longer than 30 days from the time of initial loading.

Note 2: Do not use anionic emulsified asphalt or cationic emulsified asphalt on GDOT funded Off System Projects after 30 days of initial loading.

413.3 Construction Requirements

413.3.01 Personnel

General Provisions 101 through 150.

413.3.02 Equipment

Provide equipment in good repair, including the following units that meet the requirements of [Subsection 424.3.02, Equipment.](#)

- Power broom and blower
- Pressure distributor

Provide a dedicated pressure distributor for anionic emulsified asphalt NTSS-1HM to avoid contamination with incompatible materials.

413.3.03 Preparation

General Provisions 101 through 150.

413.3.04 Fabrication

General Provisions 101 through 150.

413.3.05 Construction

A. Seasonal and Weather Limitation

Do not apply tack coat if the existing surface is wet or frozen. Do not place emulsified asphalt if the air temperature in the shade is less than 40 °F (4 °C).

B. Application

Coat the entire areas to be paved with the tack coat unless directed otherwise by the Engineer. Apply tack coat with distributor spray bars instead of hand hoses, except in small areas inaccessible to spray bars.

Application Rates for Anionic Emulsified Asphalt or Cationic Emulsified Asphalt, gal/yd² (L/m²)

Type Mix	Minimum	Maximum
All Mixes except OGFC and PEM	0.06 (0.270)	0.10 (0.450)
<ul style="list-style-type: none"> On thin leveling courses and freshly placed asphaltic concrete mixes, reduce the application rate to 0.04 to 0.06 gal/yd² (0.180 to 0.270 L/m²). Allow anionic emulsified asphalt or cationic emulsified asphalt to break for a minimum of 30 minutes after initial application. Proceed with paving only after the anionic emulsified asphalt NTSS-1HM has cured to the satisfaction of the Engineer. Do not use anionic emulsified asphalt or cationic emulsified asphalt under OGFC or PEM. 		

C. Temperature of Material

Apply bituminous materials within the temperature ranges specified below.

Bituminous Materials	Temperature of Application °F (°C)
Asphalt cement	350 - 400 (175 - 205)
Anionic Emulsified Asphalt NTSS-1HM	140 - 180 (60 - 80)
Cationic Emulsified Asphalt CRS-2h, CRS-3	140 - 180 (60 - 80)

D. Cleaning

Immediately before applying the tack coat, clean the entire area free of loose dirt, clay, and other foreign materials.

E. Application Rate

The Engineer will determine the application rate of the bituminous tack coat.

F. Limitations and Areas Coated

Apply only enough tack coat to the prepared road surface that can be covered with the new pavement course the same working day the tack coat is applied.

G. Maintenance and Protection

After applying the tack coat material, allow it to break until it is tacky enough to receive the surface course. Do not allow traffic on the tack.

413.3.06 Quality Acceptance

General Provisions 101 through 150.

413.3.07 Contractor Warranty and Maintenance

General Provisions 101 through 150.

413.4 Measurement

Bituminous materials for tack coat applied and accepted are measured as outlined in [Subsection 109.02, "Measurement of Bituminous Materials."](#)

Diluting emulsified tack coat is not ordinarily allowed except when used underneath slurry seal and approved by the Engineer. The composition of diluted emulsified tack coat defined in [Subsection 427.3.05, "Construction"](#) is measured by the gallon (liter) of diluted mix.

413.4.01 Limits

General Provisions 101 through 150.

413.5 Payment

The accepted volume of bituminous material will be paid for at the Contract Unit Price per gallon (liter) for bituminous tack coat of the type and grade approved by the Engineer, complete in place. Payment is full compensation for preparing, cleaning, furnishing, hauling, applying material, and providing incidentals to complete the work.

Payment will be made under:

Item No. 413	Bituminous tack coat	Per gallon (liter)
Item No. 413	Diluted emulsified asphalt tack coat	Per gallon (liter)

DEPARTMENT OF TRANSPORTATION

STATE OF GEORGIA

SUPPLEMENTAL SPECIFICATION

Section 424—Bituminous Surface Treatment

Delete Section 424 and substitute the following:

424.1 General Description

This work includes placing one or more applications of bituminous material and aggregate on a previously prepared base or pavement.

424.1.01 Definitions

- **Single Surface Treatment:** One application of bituminous material that is covered with aggregate.
- **Double Surface Treatment:** A bituminous material application that is covered with aggregate of the size specified in the proposal followed by a second bituminous material application that is covered with a second specified size aggregate.
- **Triple Surface Treatment:** A bituminous material application that is covered with a specified size aggregate followed by subsequent applications of bituminous material that are covered with successively smaller size nominal aggregates.

424.1.02 Related References

A. Standard Specifications

[Section 105—Control of Work](#)

[Section 800—Coarse Aggregate](#)

[Section 802—Aggregates for Asphaltic Concrete](#)

[Section 820—Asphalt Cement](#)

[Section 824—Cationic Asphalt Emulsion](#)

B. Referenced Documents

[QPL 65](#)

424.1.03 Submittals

General Provisions 101 through 150.

424.2 Materials

A. Bituminous Material

Select the bituminous material from any type and grade listed in the materials table below. Notify the Engineer at least 10 days before ordering the bituminous material. The Engineer must approve the bituminous material choice.

For a list of latex sources, see [QPL 65](#).

Ensure that materials meet the requirements of the following Specifications:

Material	Section
Asphalt Cement, Performance Grade PG 58-22 or PG 64-22*	820.2.01
Cationic Asphalt Emulsion, Grade CRS-2h or CRS-3*	824.2.01
Latex-Modified Cationic Asphalt Emulsion, Grade CRS-2L	824.2.02

* Use PG 64-22 or CRS-3 only at the Engineer's direction. (See [Subsection 424.3.05.B.](#))

B. Aggregates

The size and group of aggregates used in the surface treatment are specified in the Proposal under the appropriate Line Item.

Do not use unconsolidated limerock unless provided for in the Plans or Proposal.

Use Class B aggregates only where the surface treatment is used for shoulder construction or where it is to be overlaid with asphaltic concrete.

Material	Section
Coarse Aggregate, Class A Crushed Stone or Crushed Slag, Group I or II	800.2.01
Fine Aggregate for Asphaltic Concrete*	802.2.01

*For sand seal application, use WA 10 washed screenings made from Group II aggregates.

424.2.01 Delivery, Storage, and Handling

General Provisions 101 through 150.

424.3 Construction Requirements

424.3.01 Personnel

General Provisions 101 through 150.

424.3.02 Equipment

Have the Engineer approve equipment types and quantities before using equipment on the Project.

Ensure that the equipment used to construct the surface treatment:

- Produces work that complies with the standards in this section
- Is on the Project and in proper working order before construction begins and during construction.

A. Aggregate Spreader

The Department will inspect annually the aggregate spreader before it is used in the work. If the spreader is approved, the Department will attach an equipment certification sticker to the spreader.

Use a self-propelled aggregate spreader that can apply aggregate at the desired rate uniformly and accurately without corrugation, overlaps, or excess deficient areas.

Ensure that the spreader can spread courses to the required widths. Provide spreaders to promptly cover the full width of the asphalt application.

B. Pressure Distributor

The Department will inspect annually the pressure distributor before it is used in the work. If the distributor is approved, the Department will attach an equipment certification sticker to the distributor. The pressure distributor should be equipped as follows:

1. Mount the pressure distributor on pneumatic tires wide enough to prevent damage to the road surface.
2. Design, equip, maintain, and operate the distributor so that the bituminous material will be heated and applied evenly throughout the length of the spray bars. Ensure that it maintains a constant, uniform pressure on the nozzles.
3. Install screens between the tank and the nozzles and clean them frequently to prevent clogging.
4. Use an adjustable distributor that can deliver controlled amounts of bituminous material from 0.04 to 1.0 gal/yd², ± 0.02 gal/yd² (0.18 to 4.53 L/m², ± 0.10 L/m²) up to 24 ft (7.2 m) wide without atomization, streaking, or pulsation in the flow.
5. Use a distributor equipped with the following:
 - A tachometer and thermometers to indicate the application rate and the temperature of the tank contents
 - Measuring devices to accurately indicate the amount of bituminous material, in gallons (liters), in the distributor before and after each application
 - Full circulating spray bars that can be adjusted laterally to conform to a stringline and capable of vertical and horizontal adjustment.

- A positive shut-off control to prevent dripping bituminous material on the roadway
- A distributor tank equipped with a sample valve in a safe and convenient location to obtain bituminous material samples

C. Heating Equipment

Ensure that heating equipment will heat and maintain the bituminous material uniformly at the temperature required. Provide an accurate thermometer.

D. Steel-Wheeled Rollers

Use self-propelled, tandem-type steel-wheeled rollers. The rollers shall weigh from 3 to 8 tons (3 to 7 Mg). Ensure that the roller weights within these limits can properly seat the aggregate without fracturing the aggregate particles. Equip the roller drums with scrapers to prevent pick up of material. Combination rollers with pneumatic-tired wheels that can be alternated with a steel drum are permitted as a substitute for steel-wheeled rollers.

E. Pneumatic-Tired Rollers

Use self-propelled, two axles, pneumatic-tired rollers with smooth-tread rubber tires aligned such that gaps between the tires on one axle are covered by the tires of the other axle. Equip the roller tires with scrapers and scrubbers to prevent pick up of material. Ensure that all tires are of the same size and ply rating and inflated to a minimum of 60 psi (415 kPa). Maintain tire pressure such that the difference in pressure between any two tires does not exceed 5 psi (35 kPa). Provide ballast as directed by the Engineer.

F. Power Broom and Power Blower

Provide at least one power broom and one power blower, or a combination power broom and blower, that can remove dust or loose materials from the road surface.

424.3.03 Preparation

Firmly compact, finish, and prime new bases. Ensure that the bases conform to the lines, grades, and cross sections within the tolerances specified.

A. Removing Foreign Material

Use power brooms, power blowers, hand brooms, or other means to remove loose material, dust, dirt, clay, and other materials that prevent bituminous materials from adhering to the base.

Take special care to clean the outer edges thoroughly. Where necessary, use a motor grader blade to remove excess material off the paving edge.

B. Condition of Prime

Check the condition of prime as follows:

1. Ensure the prime is cured before placing the mat course.
2. Repair the prime if it is loose, soft, unbonded, removed, or damaged.
3. Remove concentrations of excess prime.
4. Perform additional rolling with a pneumatic-tired roller before surface treatment when directed by the Engineer.

424.3.04 Fabrication

General Provisions 101 through 150.

424.3.05 Construction

A. Observing Seasonal and Weather Limitations

Apply bituminous surface treatment only between April 15 and October 15 and only when:

- Ambient temperature has not been less than 45 °F (7 °C) for 48 hours immediately prior to application.
- No forecast of ambient temperature less than 45 °F (7 °C) for 48 hours immediately following application.
- Ambient temperature and road surface temperature is at least 60 °F (16 °C) and stable at the time of application.

No exceptions are permitted except as authorized by the Engineer.

Do not apply asphalt cement to a wet surface.

NOTE 1: When the relative humidity exceeds 80%, the ambient temperature exceeds 95 °F (35 °C), the pavement temperature exceeds 125 °F (52 °C) or the weather is windy or overcast, application of bituminous surface treatment will be at the discretion of the Engineer.

NOTE 2: If hot mix asphaltic concrete will be applied over the surface treatment, the Engineer may waive the seasonal limitations providing that traffic is not permitted on the surface treatment until it is covered with hot mix asphaltic concrete.

B. Using PG 64-22 or CRS-3

Only use PG 64-22 or CRS-3 when directed by the Engineer due to a problem with excessive aggregate pickup during high ambient temperature.

C. Observing Sequence of Operations and Quantities of Materials

The sequence of operations and quantities of materials are shown in [Table 1](#), [Table 2](#) and [Table 3](#) ([Table 1a—metric](#), [Table 2a—metric](#) and [Table 3a—metric](#)).

The Engineer will determine the material quantities to be used during construction and may change the minimum or maximum application rate of any course during construction if the total quantities are within the amounts shown in the Tables. Any deviation, or minus from the table quantities, will require a negotiated adjustment of the Contract price, which will be authorized by an approved Supplemental Agreement.

When a single application of bituminous surface treatment is used as a Crack-Relief Interlayer, use the quantities of materials shown in [Table 2](#) ([Table 2a—Metric](#)).

When a sand seal application is Specified, use the quantities of materials shown in [Table 3](#) ([Table 3a—Metric](#)).

Section 424—Bituminous Surface Treatment – Table 1

Application		Type Construction									
		Single			Double			Triple			
Stone Sizes	1st appl.		#89	#7	#6		#7	#6		#6	#5
	2nd appl.						#89	#7		#7	#7
	3rd appl.									# 89	# 89
	Control Tolerance					Control Tolerance				Control Tolerance	
1st Application Bituminous Materials (gal/yd ²) PG58-22 or PG64-22		± .02	.17-.19	.18-.25	.22-.30	± .02	.20-.27	.26-.34	± .02	.20-.30	.24-.34
CRS-2h, CRS-3		± .02	.20-.22	.21-.29	.25-.35	± .02	.23-.32	.30-.40	± .02	.23-.35	.28-.40
1st Application Stone (ft ³ /yd ²)		± .03	.14-.18	.18-.26	.30-.42	± .03	.18-.26	.30-.42	± .03	.30-.42	.41-.53
2nd Application Bituminous Materials (gal/yd ²) PG58-22 or PG64-22						± .02	.18-.24	.24-.31	± .02	.20-.27	.20-.27
CRS-2h, CRS-3						± .02	.21-.28	.28-.36	± .02	.23-.32	.23-.32
2nd Application Stone (ft ³ /yd ²)						± .03	.14-.18	.18-.26	± .03	.18-.26	.18-.26
3rd Application Bituminous Materials (gal/yd ²) PG58-22 or PG64-22									± .02	.18-.24	.18-.24
CRS-2h, CRS-3									± .02	.21-.28	.21-.28
3rd Application Stone (ft ³ /yd ²)									± .03	.14-.18	.14-.18
Total Bituminous Materials (gal/yd ²) PG58-22 or PG64-22		± .02	.17-.19	.18-.25	.22-.30	± .03	.38-.51	.50-.65	± .04	.58-.81	.62-.85
CRS-2h, CRS-3		± .02	.20-.22	.21-.29	.25-.35	± .03	.44-.60	.58-.76	± .04	.67-.95	.72-1.0
Total Stone (ft ³ /yd ²)		± .03	.14-.18	.18-.26	.30-.42	± .04	.32-.44	.48-.68	± .05	.62-.86	.73-.97
Notes:											
<ul style="list-style-type: none"> The bituminous material and stone for each application may be varied by the Engineer, at no increase in cost, outside of the minimum or maximum shown in the table provided the total of the materials is within the limits of the total minimum and total maximum of all courses. Maintain the control tolerances shown above or stop the work until the necessary corrections are made. Apply at least one seal coat to the mat course on the same day when multiple applications are specified. 											

Section 424—Bituminous Surface Treatment, Crack-Relief Interlayer – Table 2

Bituminous Material Application (gal/yd ²)	Application Rate	Control Tolerance
PG 58-22 or PG 64-22	.20 – .25	± .02
CRS-2h, CRS-2L or CRS 3	.25 – .29	± .02
Aggregate Application (ft ³ /yd ²)	Application Rate	Control Tolerance
#7	.22 – .26	± .02
Notes: <ul style="list-style-type: none"> • Target application rates for bituminous material and cover aggregate will be established by the Engineer within the limits shown in Table 2. • Maintain the control tolerances shown above or stop the work until the necessary corrections are made. • Cover the single surface treatment Crack-Relief Interlayer with HMA Leveling on the same day. 		

Section 424—Bituminous Surface Treatment, Sand Seal – Table 3

Bituminous Material Application (gal/yd ²)	Application Rate	Control Tolerance
PG 58-22 or PG 64-22	.18 – .22	± .02
CRS-2h, CRS-2L or CRS 3	.20 – .26	± .02
Aggregate Application (ft ³ /yd ²)	Application Rate	Control Tolerance
WA 10 Washed Screenings	.10 – .14	± .02
Notes: <ul style="list-style-type: none"> • Target application rates for bituminous material and seal sand will be established by the Engineer within the limits shown in Table 3. • Maintain the control tolerances shown above or stop the work until the necessary corrections are made. • Cover the coarse aggregate seal stone with seal sand on the same day. 		

Section 424—Bituminous Surface Treatment – Table 1a (Metric)

Application		Type Construction									
		Single			Double			Triple			
Stone Sizes	1st appl.		#89	#7	#6		#7	#6		#6	#5
	2nd appl.						#89	#7		#7	#7
	3rd appl.									# 89	# 89
	Control Tolerance					Control Tolerance			Control Tolerance		
1st Application Bituminous Materials (L/m ²) PG58-22 or PG64-22		± .09	.77-.86	.82-1.13	1.00-1.36	± .09	.91-1.22	1.18-1.54	± .09	.91-1.36	1.09-1.54
CRS-2h, CRS-3		± .09	.91-1.00	.95-1.31	1.13-1.58	± .09	1.04-1.45	1.36-1.81	± .09	1.04-1.58	1.27-1.81
1st Application Stone (m ³ /m ²)		± .001	.005-.006	.006-.009	.01-.014	± .001	.006-.009	.01-.015	± .001	.01-.014	.014-.018
2nd Application Bituminous Materials (L/m ²) PG58-22 or PG64-22						± .09	.82-1.09	1.09-1.40	± .09	.91-1.22	.91-1.22
CRS-2h, CRS-3						± .09	.95-1.26	1.27-1.63	± .09	1.04-1.45	1.04-1.45
2nd Application Stone (m ³ /m ²)						± .001	.005-.006	.006-.009	± .001	.006-.009	.006-.009
3rd Application Bituminous Materials (L/m ²) PG58-22 or PG64-22									± .09	.82-1.09	.82-1.09
CRS-2h, CRS-3									± .09	.95-1.27	.95-1.27
3rd Application Stone (m ³ /m ²)									± .001	.005-.006	.005-.006
Total Bituminous Materials (L/m ²) PG58-22 or PG64-22		± .09	.77-.86	.82-1.13	1.00-1.36	± .14	1.72-2.31	2.26-2.94	± .18	2.63-3.67	2.81-4.53
CRS-2h, CRS-3		± .09	.91-1.00	.95-1.31	1.13-1.58	± .14	1.99-2.72	2.63-3.44	± .18	3.04-4.30	3.26-4.53
Total Stone (m ³ /m ²)		± .001	.005-.006	.006-.009	.01-.014	± .0013	.011-.015	.016-.024	± .0016	.021-.029	.025-.033
<p>Notes:</p> <ul style="list-style-type: none"> The bituminous material and stone for each application may be varied by the Engineer, at no increase in cost, outside of the minimum or maximum shown in the table provided the total of the materials is within the limits of the total minimum and total maximum of all courses. Maintain the control tolerances shown above or stop the work until the necessary corrections are made. Apply at least one seal coat to the mat course on the same day when multiple applications are specified. 											

Section 424—Bituminous Surface Treatment, Crack-Relief Interlayer – Table 2a (Metric)

Bituminous Material Application (L/m ²)	Application Rate	Control Tolerance
PG 58-22 or PG 64-22	.91 – 1.13	± .09
CRS-2h, CRS-2L or CRS 3	1.13 – 1.31	± .09
Aggregate Application (m ³ /m ²)	Application Rate	Control Tolerance
#7	.007 – .009	± .0007

Notes:

- Target application rates for bituminous material and cover aggregate will be established by the Engineer within the limits shown in Table 2a (Metric).
- Maintain the control tolerances shown above or stop the work until the necessary corrections are made.
- Cover the single surface treatment Crack-Relief Interlayer with HMA Leveling on the same day.

Section 424—Bituminous Surface Treatment, Sand Seal – Table 3a (Metric)

Bituminous Material Application (L/m ²)	Application Rate	Control Tolerance
PG 58-22 or PG 64-22	.81 – 1.00	± .09
CRS-2h, CRS-2L or CRS 3	.90 – 1.18	± .09
Aggregate Application (m ³ /m ²)	Application Rate	Control Tolerance
WA 10 Washed Screenings	.003 – .005	± .0007

Notes:

- Target application rates for bituminous material and seal sand will be established by the Engineer within the limits shown in Table 3.
- Maintain the control tolerances shown above or stop the work until the necessary corrections are made.
- Cover the coarse aggregate seal stone with seal sand on the same day.

D. Heating Bituminous Material

Evenly heat the entire mass of bituminous material for each application under positive control. While the material is being applied, maintain it within the specified temperature range.

E. Applying Bituminous Material

The following are temperatures at which bituminous material shall be applied.

Bituminous Material	Asphalt Cement	CRS-2h	CRS-3	CRS-2L
Application temperature °F (°C)	275–350 (135–177)	140–180 (60–82)	140–180 (60–82)	140–180 (60–82)

NOTE 1: Do not store emulsified asphalts at temperatures exceeding 150 °F (65 °C) for any extended time.

NOTE 2: Do not place bituminous surface treatment on fresh asphaltic concrete, except for paved shoulders, until the asphaltic concrete has been in place at least 30 days.

The Engineer will designate the maximum area to which bituminous material may be applied at one time. Apply the material as follows:

1. After applying the bituminous material to the section, immediately cover it with the correct application rate of aggregate before beginning the next section.

Do not apply the bituminous material to the full width of the pavement unless the aggregate spreader can immediately cover the full width of the applied material.

NOTE: Never allow bituminous material to chill, set up, dry, or reach a condition that impairs the retention of cover aggregate before the aggregate is applied.

2. When a longitudinal joint is necessary:
 - Do not overlap the applications more than 4 in (100 mm).

- Do not leave any area uncovered.
 - Never allow excess quantities of bituminous materials to build up.
3. On curves that require widening:
 - a. Shoot the extra width on the outside first.
 - b. Shoot the normal width with the distributor and follow the inside paving edge.
 4. Ensure that the spray of bituminous material is uniform at all times. If the spray is not uniform:
 - a. Stop the work.
 - b. Change equipment, personnel, or methods to attain the required uniformity.
 - c. Apply bituminous material at one-half the width of the roadway, if necessary.
 5. If streaking develops:
 - a. Stop the distributor and correct the problem before proceeding.
 - b. Use a hand hose or a hand pouring pot to cover the streaked areas at approximately the same application rate of bituminous material.
 6. If a part of the work cannot be reached by the distributor, treat it by hand hoses with nozzles.
 7. Protect curbs, gutters, handrails, and other structures from discoloration by the bituminous material. Remove bituminous material that is sprayed or spilled on these structures.
 8. Ensure that the bituminous material joins neatly in place by beginning and ending the asphalt application from a heavy paper or tight trough that is longer than the width of the treatment being applied. Place it to catch and hold the surplus material.
 9. When cleaning and emptying the distributor, empty it where the bituminous material can be covered with dirt and completely disposed of without damaging the Rights-of-Way.

F. Spreading Aggregates

Spread the aggregates as follows:

1. Ensure that aggregates do not contain free moisture when spread.
2. Apply aggregate immediately after applying bituminous materials.
3. Uniformly spread the aggregate at the specified rate without corrugations, overlaps, excess, or deficient areas.
4. Move the spreader at a uniform speed, regardless of the grade.
5. Ensure that the distance that the aggregate free falls remains constant during spreading.
6. Remove corrugations. Operate the spreader to prevent overlap of aggregates. If overlap occurs, remove the excess aggregate before rolling.
7. Ensure a uniform aggregate spread by hand spotting and brooming as necessary.

G. Rolling

Observe the following guidelines for rolling bituminous surface treatment:

1. Synchronize the speed of the distributor and aggregate spreader with that of the rolling operation.
2. Use a minimum of two (2) individual rollers, one of which must be a pneumatic-tired roller meeting the requirements of Subsection 424.3.02.E.
3. If a steel-wheeled roller will fracture the aggregate, use pneumatic-tired rollers only.
4. Begin rolling within one minute after spreading the aggregate.
5. Operate rollers at speeds not exceeding 5 mph.
6. Proceed in a longitudinal direction, beginning at the outside edge of the aggregate application.
7. A roller pass is defined as one trip in a single direction.
8. Overlap each roller pass by approximately 1/2 the roller width.
9. Provide a minimum of three (3) roller passes per roller for each layer of aggregate to properly embed the aggregate particles.

Note: Unless a sufficient number of rollers are in operation to complete the above requirements, do not make subsequent applications of bituminous material until rolling of the previous application is completed.

H. Brooming

Use a revolving broom as necessary, supplemented by hand brooming, to remove or redistribute excess stone. Sweep the completed surface treatment within the first three hours of the next available workday following placement. Take care not to unseat bonded stone when sweeping.

I. Controlling Traffic

Do not allow traffic on the surface treatment until the bituminous material has cured sufficiently to ensure that the aggregate will not be loosened, dislodged, or whipped off by slow moving traffic.

Control traffic to speeds not exceeding 25 mph for a minimum of two hours after application of the seal stone and until the Engineer permits the road to be opened to normal traffic speeds.

Use pilot vehicles to control traffic speeds.

424.3.06 Quality Acceptance

General Provisions 101 through 150.

424.3.07 Contractor Warranty and Maintenance

Maintain and protect the surface course as specified in [Section 105](#) until the Project has been accepted. Make repairs as the Engineer directs. The cost of maintenance, protection, and repair is included in the Unit Prices Bid for the Item for which they apply.

424.4 Measurement

The area to be measured is the number of square yards (meters) of each type surface treatment completed and accepted.

424.4.01 Limits

The length is measured along the surface. The width is specified on the Plans, plus or minus any authorized changes. Irregular areas are measured by the surface square yard (meter) within the lines shown on the Plans or authorized changes.

424.5 Payment

The accepted area of surface treatment will be paid for at the Contract Unit Price per square yard (meter) complete for each type and stone size specified.

Payment will be made under:

Item No. 424	Single surface treatment stone size __ group__	Per square yard (meter)
Item No. 424	Double surface treatment stone size __ and __ group __	Per square yard (meter)
Item No. 424	Double surface treatment stone size __ and __ group __ with Seal Sand __ and Latex-Modified Emulsion	Per square yard (meter)
Item No. 424	Double surface treatment stone size __ and __ group __ with Seal Sand____	Per square yard (meter)
Item No. 424	Triple surface treatment stone sizes __, __ and __, group __	Per square yard (meter)

DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA

SUPPLEMENTAL SPECIFICATION

Section 445—Waterproofing Pavement Joints and Cracks

Delete Section 445 and substitute the following:

445.1 General Description

This work includes waterproofing joints and cracks in the pavement by cleaning the existing surface and placing a membrane over joints and random cracks as shown on the Plans.

445.1.01 Definitions

General Provisions 101 through 150.

445.1.02 Related References

A. Standard Specifications

[Section 150—Traffic Control](#)

[Section 400—Hot Mix Asphaltic Concrete Construction](#)

[Section 888—Waterproofing Membrane Material](#)

B. Referenced Documents

General Provisions 101 through 150.

445.1.03 Submittals

General Provisions 101 through 150.

445.2 Materials

Use membranes that meet the requirements of [Subsection 888.2.02](#). For a list of sources, see [QPL 22](#).

445.2.01 Delivery, Storage, and Handling

General Provisions 101 through 150.

445.3 Construction Requirements

445.3.01 Personnel

General Provisions 101 through 150.

445.3.02 Equipment

General Provisions 101 through 150.

445.3.03 Preparation

A. Primer

Place primer on:

- Portland cement concrete

Section 445—Waterproofing Pavement Joints and Cracks

- Old asphaltic concrete surfaces

The Engineer will determine when to place primer on new asphaltic concrete surfaces.

Before placing the membrane:

1. Prime the surface according to the manufacturer's recommendations.
2. Correct spalls greater than 3 in. (75 mm) in diameter that will prevent the material from bonding to the pavement or that will leave a cavity under the material.

Repair spalls using asphaltic concrete that meets the requirements of [Section 400](#) or other materials such as cold mixes approved by the Engineer.

3. Place the primer on the surface at the rate specified by the primer manufacturer. Extend it 1 in (25 mm) wider than the membrane. Before applying the membrane, allow the primer to dry until it is tack-free.
4. Cover the sections that are primed with membrane within the same day or repriming will be required.

445.3.04 Fabrication

General Provisions 101 through 150.

445.3.05 Construction

A. Placing the Membrane

Place the membrane on joints and cracks over concrete pavements on interstate mainline and ramps and designated state routes that will be surfaced with asphaltic concrete, unless otherwise noted on the Plans.

1. Place the membrane only when the temperature is above 40 °F (4 °C) and the pavement surfaces are dry and free of dirt or debris.
2. Install the membrane in widths of at least 11-3/8 in (290 mm) and center them over the joint or crack within a 2 in (50 mm) tolerance.
3. Seal joints as follows:
 - a. Seal transverse joints and cracks first, starting at the outside edge of the pavement and extending the full length of the joints.
 - b. Seal the longitudinal joint(s) after the transverse joints, placing the membrane in the direction that the Project will be paved.

If laps are needed, place them in the transverse and longitudinal membranes with an overlap of at least 2.5 in (65 mm).

4. Install the membrane straight and wrinkle-free with no curled or uplifted edges. Slit and fold down wrinkles over 3/8 in (10 mm) wide.
5. Press the membrane against the concrete or asphalt surface using a hand roller or other equipment to ensure proper bonding.
6. Bond the edges and corners of the strips securely to the surface. Before placing the overlay, rebond or replace strips that have loose edges or corners at no expense to the Department.
7. Place the asphaltic concrete overlay when the membrane surface is dry.
8. Traffic will be allowed to enter the section between the time of placing the membrane and placing the paving, for a maximum of 7 calendar days. Before paving, replace damaged or disbonded membrane at no additional cost to the Department.
9. Fill joints or cracks flush with the pavement if they are wider than 0.5 in (13 mm) or deeper than 3/8 in (10 mm) and not adequately filled to provide support for the membrane over the joint. Use PG 64-22 asphalt cement, hot pour, or other approved sealant material before placing the membrane as directed by the Engineer.

Section 445—Waterproofing Pavement Joints and Cracks

10. Clean the joint to remove dirt and debris before filling the joint. Comply with the short-term pavement marking requirements of [Section 150](#).

445.3.06 Quality Acceptance

General Provisions 101 through 150.

445.3.07 Contractor Warranty and Maintenance

General Provisions 101 through 150.

445.4 Measurement

The membrane quantity, complete in place and accepted, is measured in linear feet (meters). The length for transverse joints waterproofed is based on the typical cross section in the Plans, except that, where widening occurs for extra lanes, field measurements are made to determine the exact length waterproofed.

The length for longitudinal joints and random cracks waterproofed are measured in place along the center line of the joint on the surface of the pavement. No allowance is made for laps.

445.4.01 Limits

General Provisions 101 through 150.

445.5 Payment

Payment will be made at the Contract Unit Price per linear foot (meter) of joint and crack waterproofed, which will include cleaning the surface and furnishing and placing the primer and membrane.

Payment will be made under:

Item No. 445	Waterproofing pavement joints and cracks (<u>width</u>)	Per linear foot (meter)
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445.5.01 Adjustments

General Provisions 101 through 150.

Office of Materials and Research

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA**

SPECIAL PROVISION

Section 446—Placement of Pavement Reinforcement Fabric

Delete Section 446 and substitute the following:

446.1 General Description

This work includes installing Type II pavement reinforcement fabric and high strength pavement reinforcement fabric over cracks, joints, and patches in existing asphaltic concrete pavement. Install the fabric in strips or full width before placing an overlay where shown on the Plans or as directed by the Engineer. Install high strength pavement reinforcement fabric on asphaltic concrete interstate projects.

446.1.01 Definitions

General Provisions 101 through 150.

446.1.02 Related References

A. Standard Specifications

[Section 150—Traffic Control](#)

[Section 400—Hot Mix Asphaltic Concrete Construction](#)

[Section 413—Bituminous Tack Coat](#)

[Section 881—Fabrics](#)

B. Referenced Documents

General Provisions 101 through 150.

446.1.03 Submittals

General Provisions 101 through 150.

446.2 Materials

Use the reinforcement fabric that meets the requirements of [Subsection 881.2.06](#).

Bituminous binder materials, when required, shall meet the requirements of [Section 413, “Bituminous Tack Coat”](#).

446.2.01 Delivery, Storage, and Handling

General Provisions 101 through 150.

446.3 Construction Requirements

446.3.01 Personnel

General Provisions 101 through 150.

446.3.02 Equipment

A. Template

When using fabric strips, use a template or other method satisfactory to the Engineer to apply the bituminous tack coat uniformly.

B. Mechanical Device

Use a mechanical device approved by the Engineer when placing the fabric full width on the pavement to ensure the fabric is placed smooth, free of wrinkles, and with no uplifted edges.

C. Roller

Place the fabric in total contact with the underlying pavement. Roll the fabric with a static drum or pneumatic roller to ensure adequate adhesion to the pavement surface.

446.3.03 Preparation

Before an existing pavement surface is milled, mark the location of joints and cracks with an offset reference so that they can be located after milling has been completed.

A. Cleaning the Pavement

Immediately before applying the bituminous tack coat, clean the pavement surface to remove rocks, dirt, debris, and other materials that may prevent a clean bonding surface.

B. Repairing Potholes, Spalls, or Cracks

Before placing the fabric, repair potholes, spalls, or cracks greater than 3/16 in (5 mm) wide. Repair spalls and potholes using asphaltic concrete that meets the requirements of [Section 400](#) or other materials such as cold mixes approved by the Engineer.

Fill cracks with PG 64-22 asphalt cement or other materials approved by the Engineer.

446.3.04 Fabrication

General Provisions 101 through 150.

446.3.05 Construction

Do not install reinforcement fabric when ambient temperatures are less than 45 °F (7 °C).

Use a bituminous tack coat when temperatures are between 45°F (7 °C) and 70°F (21°C) for all reinforcement fabric types.

When ambient temperatures are a minimum of 70 °F (21 °C) and rising, reinforcement fabric with a self-adhesive backing may be installed at the Contractor's option without applying a bituminous tack coat except when the fabric is placed on a milled surface.

Use a bituminous tack coat when fabric is placed on a milled surface regardless of the temperature.

A. Applying Bituminous Binder

Use a bituminous tack coat to bond self-adhesive fabric to the pavement and apply the bituminous tack coat at a rate of 0.10 gal/yd² (0.45 L/m²) over non-milled surfaces and 0.20 gal/yd² (0.90 L/m²) over milled surfaces. Heat the bituminous tack coat and apply within a temperature range of 350 °F to 375 °F (175 °C to 190 °C).

Use bituminous tack coat to bond non-self-adhesive fabric to the pavement and apply at a rate of 0.10 gal/yd² (0.45 L/m²) over non-milled surfaces and 0.25 gal/yd² (1.13 L/m²) over milled surfaces. Heat the bituminous tack coat and apply within a temperature range of 350 °F to 375 °F (175 °C to 190 °C).

Where using fabric strips, use a template or other method satisfactory to the Engineer to apply bituminous tack coat uniformly.

Do not allow the width of the bituminous tack coat applied to exceed the width of the fabric by more than 1 in (25 mm) on each side.

B. Placing the Fabric

For self-adhesive reinforcement fabric, remove the release liner of the fabric and place the adhesive side to the pavement. Place self-adhesive reinforcement fabric no more than 24 hours in advance of the paving operation to ensure proper adhesion of the fabric to the pavement.

Place non-self-adhesive reinforcement fabric at least 1 hour but no more than 24 hours in advance of the paving operation to ensure proper adhesion of the fabric to the pavement. Place fabric on the pavement immediately after the bituminous tack coat has been applied to the pavement. Place the non-woven polyester side of the fabric on the pavement.

Install the fabric so that it is smooth, free of wrinkles with no uplifted edges. Provide a minimum of 5 in (125 mm) overlap on all sides of the repair area. Center the material over the repair area within a 2 in (50 mm) tolerance. When placed full width, use a mechanical device approved by the engineer to place the fabric on the pavement.

Immediately after the fabric is placed on the pavement, ensure that the fabric is in total contact with the underlying pavement. Roll the material with a static drum or pneumatic roller to ensure adequate adhesion to the pavement surface.

Any fabric with loose edges, corners or other improperly bonded areas shall be replaced at the expense of the Contractor prior to placement of the overlay or opening the fabric section to traffic.

C. Overlapping Fabric.

If more than one strip of fabric is required to cover the repair area, the seams that are created shall be butt or lapped seams. When waterproofing is required, use lap seams with a minimum 2 in (50 mm) overlap. Make all lapped seams in the direction of the paving operation to prevent pickup by the paving train. The width of the fabric strips shall be shown on the plans.

Make joint overlaps to prevent pickup by the paving train that places the asphaltic concrete.

D. Protecting Fabric

When full width fabric is used, schedule work so that the fabric will be covered with asphaltic concrete prior to reopening the section to traffic. Do not allow traffic, other than necessary construction equipment or emergency vehicles, on unprotected fabric. If approved by the Engineer, traffic will be allowed to use a section with applied fabric strips for a maximum of 7 days. Coordinate all activities to conform to this restriction. Replace any damaged fabric prior to paving at the Contractor's expense. When short-term pavement markings are required, the markings shall meet the requirements of [Section 150](#).

When in-place fabric is exposed to moisture prior to application of the overlay, make sure the fabric is completely dry before the overlay is placed.

If the fabric sticks to tires of trucks or paving equipment during the construction overlays, hot mix asphalt may be broadcast over the fabric for protection.

E. Placing Overlay

Use an asphaltic concrete overlay that meets the requirements of [Section 400](#).

Prior to placement of the overlay, apply a bituminous tack coat over the fabric at a rate determined by the Engineer as described in [Subsection 400.3.03.A.3](#).

The minimum thickness of asphaltic concrete over the strip shall be 2 in (50 mm). Milling may be required to provide the minimum thickness.

When using a vibratory roller for compaction, avoid the use of excessive amplitude. The use of excessive amplitude during the compaction process may result in an undesirable riding surface.

446.3.06 Quality Acceptance

General Provisions 101 through 150.

446.3.07 Contractor Warranty and Maintenance

General Provisions 101 through 150.

446.4 Measurement

The reinforcement fabric complete, in place, and accepted is measured by the square yard (meter) for full-width fabric, or by the linear foot (meter) for fabric strips. No allowance will be made for laps.

446.4.01 Limits

General Provisions 101 through 150.

446.5 Payment

Payment will be made at the Contract Unit Price per square yard (meter) or per linear foot (meter) of reinforcement fabric as shown in [Subsection 446.4, "Measurement."](#)

Payment is full compensation for the work specified in this section, including cleaning the surface and furnishing and placing the pavement reinforcement fabric.

Payment for Pavement Reinforcing Fabric Strips also includes all milling required to place the fabric according to the plans.

Payment will be made under:

Item No. 446	Pavement Reinforcement Fabric Strips, Type II, 18 inch (450 mm) Width	Per linear foot (meter)
Item No. 446	Pavement Reinforcement Fabric Full Width, Type II	Per square yard (meter)
Item No. 446	High Strength Pavement Reinforcement Fabric, 18 inch (450 mm) Width	Per linear foot (meter)

446.5.01 Adjustments

General Provisions 101 through 150.

Office of Materials and Research

DEPARTMENT OF TRANSPORTATION

STATE OF GEORGIA

SUPPLEMENTAL SPECIFICATION

Section 456—Indentation Rumble Strips

Delete Section 456 and substitute the following:

456.1 General Description

This work includes constructing rumble strips on paved shoulders or centerlines by milling or grinding 1/2 in (13 mm) deep depressions into the finished surface as shown in the Plans.

456.1.01 Definitions

Skip ground in place rumble strips—Rumble strips placed with 28 ft (8.5 m) of strips and 12 ft (3.7 m) of clear space between.

Continuous ground in place rumble strips—Rumble strips placed continuously.

Edge line rumble strips – Rumble strips placed continuously on the edge line traffic stripe.

Centerline rumble strips – Rumble strips placed continuously on the centerline traffic striping.

456.1.02 Related References

A. Standard Specifications

General Provisions 101 through 150.

B. Referenced Documents

General Provisions 101 through 150.

456.1.03 Submittals

General Provisions 101 through 150.

456.2 Materials

General Provisions 101 through 150.

456.2.01 Delivery, Storage, and Handling

General Provisions 101 through 150.

456.3 Construction Requirements

456.3.01 Personnel

General Provisions 101 through 150.

456.3.02 Equipment

A. Cutting Tool

Use a cutting tool that meets these requirements:

- Has independent suspension from the power unit to allow the tool to self-align with the slope of the shoulder
- Is equipped with guides to provide consistent alignment of each line of indentations in relation to the roadway
- Houses a single rotary-type milling/grinding head in line in the direction of travel
- The cutting tips on the milling/grinding head are arranged to provide a smooth cut with no more than 0.05 in (1 mm) between the peaks and valleys

456.3.03 Preparation

Section 456—Indentation Rumble Strips

General Provisions 101 through 150.

456.3.04 Fabrication

General Provisions 101 through 150.

456.3.05 Construction

A. Indentations

Form the rumble strip indentations as follows:

1. For traveled ways opened to traffic, install the indentations within ten calendar days.
2. Ensure the finished indentations conform to the following:
 - a. Indentations have a concave circular shape and are spaced 12 in (300 mm) center to center.
 - b. Skip, continuous, and centerline rumble strips indentation dimensions:
 - 7 in (175 mm) wide with a 5 in (125 mm) gap in the direction of travel
16 in (400 mm) long when measured perpendicular to the direction of travel.
 - Minimum 1/2 in (13 mm) maximum 5/8 in (16 mm) deep at center.
 - c. Edge line rumble strip indentation dimension:
 - 7 in (175 mm) wide with a 5 in (125 mm) gap in the direction of travel
 - 6 in (150 mm) long when measured perpendicular to the direction of travel.
 - Minimum 1/2 in (13 mm) maximum 5/8 in (16 mm) deep at center.

Excess waste material resulting from the operation may be swept to the grassed shoulder and spread where applicable. If an adjacent grassed shoulder is not available, or if directed by the Engineer, remove and dispose of the waste material in a manner approved by the Engineer.

456.3.06 Quality Acceptance

General Provisions 101 through 150.

456.3.07 Contractor Warranty and Maintenance

General Provisions 101 through 150.

456.4 Measurement

Indentation rumble strips are measured by the gross linear mile (kilometer). The Plan quantity is the pay quantity unless the Engineer makes authorized changes. No deductions will be made for intersections, ramps, bridges, or skips.

456.4.01 Limits

General Provisions 101 through 150.

456.5 Payment

Payment will be made at the Contract Unit Price bid per gross linear mile (kilometer). Payment is full compensation for furnishing equipment and labor and for satisfactorily performing the work.

Payment will be made under:

Item No. 456	Indentation rumble strips—ground in place (continuous)	Per gross linear mile (kilometer)
Item No. 456	Indentation rumble strips—ground in place (skip)	Per gross linear mile (kilometer)
Item No. 456	Indentation edge line rumble strips—ground in place (continuous)	Per gross linear mile (kilometer)
Item No. 456	Indentation centerline rumble strips—ground in place (continuous)	Per gross linear mile (kilometer)

456.5.01 Adjustments

General Provisions 101 through 150.

Office of Traffic Operations

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA**

SPECIAL PROVISION

Section 500—Concrete Structures

Add the following to Section 500.1:

See the Contract Plans for the specified color and locations for placing integrally colored concrete.

Add the following to Subsection 500.1.02.B:

ASTM C 979

Add the following to Subsection 500.1.03:

H. Color Additives

Submit to the Engineer the following:

- a. Product Data: Manufacturer's specifications and instructions for color additives.
- b. Samples for Concrete Color Selection: Submit sample chip of specified color indicating color additive number and required dosage rate. Submittals are for general verification of color.

Add the following to Section 500.2:

Use colored concrete additive made with pure, concentrated mineral pigments especially processed for mixing into concrete and complying with ASTM C 979.

If adding color additives to the mix at the jobsite, furnish color additives in pre-measured Mix-Ready disintegrating bags to minimize jobsite waste.

Do not use accelerator admixtures containing calcium chloride in colored concrete mix.

Add the following to Subsection 500.2.01:

H. Color Additives

Comply with manufacturer's instructions. Deliver to site or batch plant in original, unopened packaging. Store color additives in dry conditions.

Add the following to Subsection 500.3.04.E:

4. Colored-Mixed Concrete
 - a. Proportion, batch and mix color additives in accordance with manufacturer's instructions. Mix until color additives are uniformly dispersed throughout mixture and disintegrating bags, if used, have disintegrated.
 - b. If mixed at batch plant, schedule delivery of concrete to provide consistent mix times from batching until discharge.

Section 500—Concrete Structures

Add the following to Subsection 500.3.05.A:

4. Schedule placement to minimize exposure of freshly poured concrete to potentially harmful drying elements such as wind and sun before curing materials are applied and protect freshly poured concrete from exposure to excess moisture and freezing for a minimum of 24 hours when such weather conditions exist.

Delete Subsection 500.3.05.T.9.c and substitute the following:

- c. After belting, dragging, or brooming and when shown on the Plans, groove the bridge deck and approach slabs perpendicular to the center line as follows:
 - 1) Do not begin grooving until the bridge deck is cured according to Subsection 500.3.05.Z, “Cure Concrete”.
 - 2) If necessary, groove in conjunction with planing required to make the surface corrections specified in Subsection 500.3.06.D, “Bridge Deck Surface Check”. Wait until the concrete is hard enough to support the equipment without distorting.
 - 3) Cut Grooves into the hardened concrete using a mechanical saw device capable of producing grooves 0.125 in (3 mm) wide, 0.125 in (3 mm) deep, and 0.5 in (13 mm) apart, center-to-center.
 - 4) Extend the grooves across the slab to within 1 ft (300 mm) of the gutter lines.

Add the following to Subsection 500.3.05.Z:

Cure colored concrete in accordance with manufacturer’s instructions.

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SUPPLEMENTAL SPECIFICATION

Section 520—Piling

Delete Subsection 520.3.05.D.2 and substitute the following:

2. Perform Loading Test

Unless otherwise specified on the Plans, use a test method that conforms to ASTM D 1143, modified for quick load tests.

Use loading apparatus capable of the lesser value of the following:

- For concrete piles, 400 percent of the design load or 500 tons (4450 kilonewtons)
- For steel piles, 400 percent of the design load or 90 percent of the yield strength

The Engineer may increase or decrease the number of loading tests.

Furnish and read the instrumentation necessary to determine the pile settlement under load.

A loaded pile is unsatisfactory when the total settlement under 200 percent of the design load exceeds 1 in (25 mm) or the permanent settlement exceeds 1/4 in (6 mm) using the standard loading procedure in ASTM D 1143 Section 5.

The laboratory will determine the maximum safe design load or the failure load of original loading materials based on the results of the loading test.

The Engineer may require the following piles to be driven further:

- Unsatisfactory piles as defined in the paragraphs above
- Piles without enough maximum safety design or failure loads as determined by the Office of Materials and Research

Perform the loading test as follows:

- a. Test load piling as required on the Plans, or as directed by the Engineer.
- b. Furnish and drive the piling to be test loaded.
- c. Furnish and drive necessary anchor piling.
When the Engineer permits, use piling that will remain in the completed structure after load testing as anchor piles when desired.
- d. Apply the test loads in equal increments of 10 to 15 percent of the design load.
- e. Apply the loads at constant 2-1/2-minute time intervals throughout the test.
- f. After the test is complete, remove the temporary materials. These temporary materials remain the Contractor's property.
- g. Remove or cut off the piling that will not remain in the completed structure.
Cut off the piling at least 1 ft (300 mm) below the bottom of the footing or the ground line, whichever applies.
- h. In deep water, have the Engineer direct how much pile to remove.

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SPECIAL PROVISION

Section 550—Storm Drain Pipe, Pipe-Arch Culverts, and Side Drain Pipe

Delete Section 550 and Substitute the following:

550.1 General Description

This work includes furnishing and installing the following:

- Storm drain pipe
- Pipe-arch and elliptical culverts
- Side drain pipe flared end sections
- Tapered pipe inlets

Install structures according to the Specifications and the details shown on the Plans, or as directed by the Engineer.

550.1.01 Definitions

General Provisions 101 through 150.

550.1.02 Related References

A. Standard Specifications

[Section 205—Roadway Excavation](#)

[Section 207—Excavation and Backfill for Minor Structures](#)

[Section 208—Embankments](#)

[Section 645—Repair of Galvanized Coatings](#)

[Section 815—Graded Aggregate](#)

[Section 834—Masonry Materials](#)

[Section 840—Corrugated Aluminum Alloy Pipe](#)

[Section 841—Iron Pipe](#)

[Section 843—Concrete Pipe](#)

[Section 844—Steel Pipe](#)

[Section 845—Smooth Lined Corrugated High Density Polyethylene \(HDPE\) Culvert Pipe](#)

[Section 846—Polyvinyl chloride \(PVC\) Drain Pipe](#)

[Section 847—Miscellaneous Pipe](#)

[Section 848—Pipe Appurtenances](#)

B. Referenced Documents

General Provisions 101 through 150.

GDOT Manual on Drainage Design for Highways

Ga. Std. 1030D

Ga. Std. 1030P

GDT 136

550.1.03 Submittals

General Provisions 101 through 150.

550.2 Materials

Ensure that materials meet the requirements of the following Specifications:

Material	Section
Backfill Materials	207
Graded Aggregate	815.2.01
Reinforced Concrete Pipe	843.2.01
Nonreinforced Concrete Pipe	843.2.02
Mortar And Grout	834.2.03
Bituminous Plastic Cement	848.2.05
Rubber Type Gasket Joints (Concrete Pipe)	848.2.01
Preformed Plastic Gaskets	848.2.06
Corrugated Steel Pipe	844.2.01
Bituminous Coated Corrugated Steel Pipe	844.2.02
Corrugated Aluminum Alloy Pipe	840.2.01
Bituminous Coated Corrugated Aluminum Pipe	840.2.03
Aluminized Type 2 Corrugated Steel Pipe	844.2.06
Ductile Iron Pipe, Fittings and Joints	841
Precoated, Galvanized Steel Culverts	844.2.05
Smooth Lined Corrugated High Density (HDPE) Polyethylene Culvert Pipe	845.2.01
Polyvinyl Chloride (PVC) Profile Wall Drain Pipe	846.2.01
Polyvinyl Chloride (PVC) Corrugated Smooth Interior Drain Pipe	846.2.02
Miscellaneous Pipe	847

Use any of the following types of pipe:

- Reinforced concrete
- Nonreinforced concrete
- Corrugated steel or Aluminum
- Smooth-lined corrugated high density polyethylene (HDPE)
- Ductile iron
- Polyvinyl Chloride (PVC) Profile Wall Drain Pipe
- Polyvinyl Chloride (PVC) Corrugated Smooth Interior Drain Pipe

Use the type of pipe designated on the Plans, or acceptable alternate types when applicable. For a display of acceptable alternate pipe types see Selection Guideline for Culvert, Slope and Underdrain Pipe in Chapter 10 – Material Selection of the Department’s Manual on Drainage Design for Highways. This document summarizes general applications for pipe.

For concrete, corrugated steel and aluminum pipe see Ga. Std. 1030D for minimum thicknesses, minimum cover, maximum fill, allowable pipe diameters and trench construction detail.

For HDPE and PVC pipe see Ga. Std. 1030P for minimum cover, maximum fill, allowable pipe diameters and trench construction detail.

550.2.01 Delivery, Storage, and Handling

General Provisions 101 through 150.

550.3 Construction Requirements

550.3.01 Personnel

General Provisions 101 through 150.

550.3.02 Equipment

General Provisions 101 through 150.

550.3.03 Preparation and Backfill

Before installing pipe, shape the foundation material as shown on the Plans.

Prepare structure excavations and foundation according to [Section 207](#). Except, for HDPE and PVC pipe use the following requirements for backfill:

1. Cross drain applications use material that meets [Subsection 815.2.01](#).
2. Longitudinal and side drain applications use material according to [Section 207](#). Except, when Type I backfill material is required use Class II B2 soil or better per [Subsection 810.2.01](#).

550.3.04 Fabrication

General Provisions 101 through 150.

550.3.05 Construction

A. Drainage

Provide necessary temporary drainage. Periodically remove any debris or silt that constricts the pipe flow to maintain drainage throughout the life of the Contract.

B. Damage

Before allowing construction traffic over a culvert, protect the structure by providing sufficient depth and width of compacted backfill. Repair damage or displacement from traffic or erosion that occurs after installing and backfilling at no additional cost to the Department.

C. Installation

Check vertical and horizontal alignment of the pipe culvert or storm drain pipe barrel by sighting along the crown, invert and sides of the pipe, and by checking for sagging, faulting and invert heaving. Repair any issues involving incorrect horizontal and/or vertical alignment before backfilling pipe.

1. Concrete Pipe

Lay sections in a prepared trench with the socket ends pointing upstream. Join section using either rubber gasket or preformed flexible sealant, installed according to the manufacturer's recommendations.

2. Ductile Iron Pipe

Lay pipe sections in a prepared trench, with bells pointing upstream. Construct joints according to [Subsection 841.2.02.A](#).

3. Corrugated Aluminum or Steel Pipe and Pipe-Arches

Lay pipe sections in a prepared trench, with outside laps of circumferential joints pointing upstream and longitudinal joints at the sides. Join the sections with coupling bands, fastened by two or more bolts. Before backfilling the structure:

- a. Repair exposed base metal in metal coating according to [Section 645](#).
- b. Recoat exposed base metal in bituminous coating with asphalt.

4. Smooth-Lined Corrugated HDPE Pipe

Install smooth-lined corrugated HDPE pipe according to ASTM D 2321. Use fitting and couplings that comply with the joint performance criteria of AASHTO Standard Specifications for Highway Bridges, Division II. Ensure that all joints are “silt tight” as stated in the AASHTO bridge specifications.

5. Specials (Wyes, Tees, and Bends)

Install wyes, tees, and bends as shown on the Plans or as directed.

6. Tapered Pipe Inlets

Locate and install tapered pipe inlet end sections as shown on the Plans or as directed.

7. Elongation

Elongate metal pipe as shown on the Plans. Order the elongation of the vertical axis of the pipe to be done in the shop.

Have the manufacturer ship metal pipe with wire ties in the pipe ends. Remove wire-ties immediately after completing the fill.

8. Flared End Sections

Use flared end sections on the inlet, outlet, or on both ends of storm drain pipe, according to Plan details.

9. PVC Drain Pipe

Install polyvinyl chloride (PVC) drain pipe according to ASTM D 2321. Use fittings and couplings that comply with the joint performance criteria of AASHTO Standard Specifications for Highway Bridges, Division II. Ensure that all joints are “silt tight” as stated in the AASHTO bridge specifications.

550.3.06 Quality Acceptance

A. Post Installation Inspection

Inspect 100% of pipe under the roadbed, 100% of pipe in a closed drainage system and a minimum of 10.0 % of all other locations except in side drain application which are short enough to inspect from each end of the pipe. Conduct post installation inspections in accordance with the requirements of this Specification and GDT 136.

Before post installation inspection, dewater installed pipe (if necessary) and provide the Project Engineer with a post installation inspection schedule. Notify the Project Engineer at least seven days in advance of beginning inspection. Perform post installation inspection no sooner than 30 calendar days after completion of the pipe installation and final cover, which includes the embankment and all non-asphalt bases and/or subgrades. When paving operations are conducted in less than 30 calendar days, perform a brief preliminary inspection of the pipe prior to paving to ensure the pipe has been properly installed and is performing well. Notify the Project Engineer of problems found during the preliminary inspection. The Project Engineer will determine if corrective action is necessary. Performing a preliminary inspection does not relieve the Contractor from the requirement of performing the post installation inspection after the 30 calendar day period.

Perform post installation inspection with the use of low barrel distortion video equipment with laser profile technology, non-contact video micrometer and associated software.

Video and laser profiling and measurement technology must be certified by the company performing the work to meet the requirements of GDT 136. Inspection contractor personnel completing remote inspections shall be NASSCO – PACP Certified Technicians.

For video recorded, laser profiled pipe that indicates deflection is in excess of Specification requirements, the Contractor may elect to further test the pipe with the use of a mandrel. Ensure mandrel meets requirements of GDT 136 and the Project Engineer has approved before use. Pull the mandrel by hand.

Manual post installation inspection allowed for pipe diameters greater than 48 inches per Subsection 550.3.06.B.

B. Manual Post Installation Inspections

Perform a manual inspection by entering the pipe structure to record video and to make measurements. For all pipe structures considered a confined space, provide entry for all project inspection personnel according to OSHA requirements. Furnish a video recording of each inspection. On the recording, identify the date and time of the inspection, a description of the pipe structure, location, and viewing direction. Record the entire run of pipe. Provide a light source which allows observation of all areas of concern on the video recording. Furnish the video recording in a digital, reproducible format on one of the following media types: DVD or CD.

Measure the deflection of the pipe using either a metal or fabric tape and read to the nearest 0.5 inch (10 mm). Measure crack width using either a crack comparator or a feeler gage capable of measuring 0.01 inch (0.25 mm). Measure joint

gaps using a tape or ruler and read to the nearest 0.5 inch (10 mm). Other measuring devices may be used if approved by the Project Engineer.

Record the measurements and include them in the inspection report. Measure and record the following:

1. The location, length and greatest width of each crack.
2. Smallest inside diameter three times for each pipe section in the run. Take the first measurement vertically from the crown to invert (12 o'clock to 6 o'clock positions). Take the second measurement by rotating 60 degrees from vertical (2 o'clock to 8 o'clock positions). Take the third measurement by rotating 120 degrees from vertical (4 o'clock to 10 o'clock positions). For all measurements, stretch tape to full extent across inside of pipe.
3. Widest gap at each joint in the run.

Record the location and describe other defects not listed above. For each measurement location in a pipe, record the length from the nearest drainage structure.

C. Inspection Report

Submit inspection report to the Project Engineer after completion of the required post installation inspection. Ensure inspection report meets the requirements of this Specification and GDT 136.

D. Requirements for Concrete Pipe:

1. Joints: Note differential movement, cracks, spalling, improper gasket placement, movement or settlement of pipe sections, and leakage in the inspection report. Repair or replace pipe sections to the satisfaction of the Project Engineer where joint separation is greater than one inch. Repair or replace pipe sections where soil migration through the joint is occurring.
2. Longitudinal and Transverse Cracks: Cracks with a width less than 0.01 inch (0.25 mm) are considered hairline and minor and only need to be noted in the inspection report, no corrective action is necessary. When cracks are wider than 0.01 inch (0.25 mm) and extend for a length of 12 inch (300 mm) or more, regardless of position in the wall of the pipe, measure the width, length, and locations of the cracks and diameter of the pipe, both horizontally and vertically, and submit to the Project Engineer for review and approval an evaluation utilizing a Professional Engineer that takes into consideration structural integrity, environmental conditions, and the design service life of the pipe.

Seal by a method approved by the Project Engineer cracks having widths equal to or greater than 0.01 inch (0.25mm) that extend for a length of 12 inch (300 mm) or more and determined to be detrimental. Remediate or replace pipe with cracks widths greater than 0.1 inch (2.5 mm) and determined by the Project Engineer to be beyond satisfactory structural repair. Repair or replace pipes having displacement across the crack.

E. Requirements for Smooth-Lined Corrugated HDPE & PVC Drain Pipe

1. Joints: Remediate pipe showing evidence of crushing at the joints. Note differential movement, improper joint sealing, movement or settlement of pipe sections, and leakage in the inspection report. Remediate joint separation of greater than 1 inch. Repair or replace pipe sections where soil migration through the joint is occurring.
2. Cracks: Remediate cracks or splits in the interior wall of the pipe. Use remediation methods in accordance with recommendations of the pipe manufacturer and accepted and authorized by the Project Engineer.
3. Buckling, bulging, and racking: Note in the inspection report flat spots or dents at the crown, sides or flowline of the pipe due to racking. Note areas of wall buckling and bulging in the inspection report. The Project Engineer will determine if corrective action is necessary.
4. Deflection: Where pipe deflection exceeds 5% of the nominal diameter, submit to the Project Engineer for review and approval an evaluation utilizing a Professional Engineer that takes into consideration the severity of the deflection, structural integrity, environmental conditions, and the design service life of the pipe. Remediate or replace pipe where the evaluation finds that the deflection could be problematic or where pipe deflection exceeds 7.5% of the nominal diameter.

F. Requirements for Corrugated Aluminum or Coated Steel Pipe

1. Joints: Remediate pipe showing evidence of crushing at the joints. Note differential movement, improper joint sealing, movement or settlement of pipe sections, and leakage in the inspection report. Remediate joint separation of greater than 1 inch. Repair or replace pipe sections where soil migration through the joint is occurring.

2. Cracks: Remediate cracks or splits in the interior wall of the pipe. Use remediation methods in accordance with recommendations of the pipe manufacturer and accepted and authorized by the Project Engineer.
3. Buckling, bulging, and racking: Note flat spots or dents at the crown, sides or flowline of the pipe due to racking in the inspection report. Note areas of wall buckling and bulging in the inspection report. The Project Engineer will determine if an additional evaluation by a Professional Engineer is required. Remediate or replace pipe where the evaluation finds that the damaged section could be problematic.
4. Deflection: Where pipe deflection exceeds 5% of the nominal diameter, submit to the Project Engineer for review and approval an evaluation utilizing a Professional Engineer that takes into consideration the severity of the deflection, structural integrity, environmental conditions, and the design service life of the pipe. Remediate or replace pipe where the evaluation finds that the deflection could be problematic or where pipe deflection exceeds 7.5% of the nominal diameter.
5. Coating: Note areas of the pipe where the original coating has been scratched, scoured or peeled in the inspection report. The Project Engineer will determine if repair is necessary. Use remediation methods in accordance with recommendations of the pipe manufacturer and accepted and authorized by the Project Engineer.

550.3.07 Contractor Warranty and Maintenance

General Provisions 101 through 150.

550.4 Measurement

A. Excavation and Backfill

Backfill materials types II and III are measured according to [Subsection 207.4, "Measurement."](#)

B. Flat Bottom and Circular Pipe (All Types)

The overall length of pipe installed, excluding tapered inlets, is measured in linear feet (meters), along the central axis of the diameter of the pipe. Wyes, tees, and bends are included in this measurement.

C. Pipe-Arches

The overall length of pipe-arch installed is measured in linear feet (meters), along the bottom center line of the pipe.

D. Multiple Installations

In multiple installations, each single line of culvert structure is measured separately.

E. Tapered Pipe Inlets

Tapered pipe inlet sections are measured as a unit; do not include them in the overall length of the pipe.

F. Flared-End Sections

Flared-end sections are measured separately by the unit and not included in the overall pipe length.

G. Smooth-Flow Pipe

Smooth-flow pipe is measured by the linear foot (meter) along the pipe invert.

H. Elliptical Pipe

Elliptical pipe is measured in linear feet (meters) along the bottom center line of the pipe.

I. Post Installation Inspection

No measurement will be made for post installation inspection.

550.4.01 Limits

Excavation and normal backfill are not measured for payment.

550.5 Payment

A. Backfill

Backfill will be paid for according to [Section 207](#).

B. Pipe Installations

Pipe installations complete in place and accepted will be paid for at the Contract Price for each item.

This payment is full compensation for excavating, furnishing, and hauling materials; installing, cutting pipe where necessary; repairing or replacing damaged sections; post installation inspection, making necessary connections; strutting, elongating, providing temporary drainage; joining an extension to an existing structure where required; and removing, disposing of, or using excavated material as directed by the Engineer.

1. Smooth Flow Pipe

The quantity of each diameter and steel thickness of smooth flow pipe as measured will be paid for at the Contract Unit Price per linear foot (meter) bid for the various sizes. Payment is full compensation for furnishing labor, materials, tools, O-ring mechanical joints, equipment, and incidentals to complete this Item, including removing and disposing excavation material.

2. Flared-End Sections

Flared-end sections, measured as specified above, will be paid for at the Contract Unit Price for each section of the specified size.

Payment will also include sawing, removing, and replacing existing pavement removed to install a new drainage structure.

Payment will be made under:

Item No. 550	Storm drain pipe ___ in (mm), H=___	Per linear foot (meter)
Item No. 550	Side drain pipe ___ in (mm), H=___	Per linear foot (meter)
Item No. 550	Pipe arch (span) ___ in (mm) x (rise) ___ in (mm)	Per linear foot (meter)
Item No. 550	Tapered pipe inlet ___ in (mm),	Per each
Item No. 550	Flared-end section ___ in (mm),	Per each
Item No. 550	Elliptical pipe ___ in (mm) wide x ___ in (mm) high	Per linear foot (meter)

550.5.01 Adjustments

Excavation will not be paid for separately, but the other provisions of [Section 205](#) and [Section 208](#) shall govern.

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**DEPARTMENT OF TRANSPORTATION
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SUPPLEMENTAL SPECIFICATION

Add the following:

Section 572—Slope Underdrains

572.1 General Description

This Work consists of the construction of slope underdrains, including placement of Geogrid reinforcement, Geocomposite wall drains, plastic filter fabric and other materials in slope excavations or fills where encountering high groundwater. Perform this Work in accordance with the Specifications and details, lines and grades shown on the Plans, or as directed by the Engineer.

572.1.01 Definitions

General Provisions 101 through 150.

572.1.02 Related References

A. Standard Specifications

General Provisions 101 through 150.

[Section 500—Concrete Structures](#)

[Section 603—Sand-cement Bag Rip Rap](#)

[Section 806—Aggregate for Drainage](#)

[Section 809—Geogrid Materials](#)

[Section 839—Corrugated Polyethylene Underdrain Pipe](#)

[Section 853—Reinforcement and Tensioning Steel](#)

[Section 881—Fabrics](#)

B. Referenced Documents

[QPL 28](#)

[QPL 47](#)

572.2 Materials

Ensure that materials meet the requirements of the following Specifications:

Material	Section
Concrete	500
Sand-cement Bag Rip Rap	603
Coarse Aggregate for Underdrains	806.2.01
Geogrid	809

Material	Section
Corrugated Polyethylene Underdrain Pipe	839
Reinforcing Steel	853
Woven Plastic Filter Fabric	881.2.05

Use approved geocomposite wall drain listed on QPL 47.

See QPL 28 for acceptable woven fabrics that meet the requirements of this Specification.

572.3 Construction Requirements

572.3.01 Personnel

General Provisions 101 through 150.

572.3.02 Equipment

General Provisions 101 through 150.

572.3.03 Preparation

General Provisions 101 through 150.

572.3.04 Fabrication

General Provisions 101 through 150.

572.3.05 Construction

Arrange the work schedule so that the slope underdrain installations will coincide with other operations on the Project in a manner that will prevent damage to completed work or may cause and/or allow soil contamination of materials.

A. Excavation

Excavate in accordance with the details and elevations shown on the Plans or to an additional depth as directed by the Engineer to intercept the water-bearing strata encountered during construction. Begin the excavations with the topmost bench and proceed to the bottom of the slope. Excavate as necessary to provide continuous slope underdrain coverage from the top of the water-bearing strata to the bottom of the slope. When encountering unstable conditions in the bottom of the excavation, remove unstable material as directed by the Engineer and replace with approved granular material and compact so as to provide a stable foundation for the excavation and placement of pipes.

B. Placement of Geocomposite Wall Drains

Place the Geocomposite wall drains the full height and width of the vertical bench cuts and secure the drains with metal staples or wooden stakes. Do not allow any horizontal joints or splices to remain in the drains. Abut adjoining drain strips to make vertical joints between drain strips.

C. Placement of Plastic Filter Fabric

Place plastic filter fabric of sufficient length to cover the drainage aggregate at the bottom of the bench excavation adjacent to the geocomposite wall drain. Overlap the fabric with a minimum of 3 feet (914 mm) of material. Sewing of the fabric will not be required. The fabric may be cut at the locations of the solid underdrain pipe to allow for wrapping around the drainage aggregate.

D. Placement of Pipe and Aggregate

Place perforated pipe continuous with the bench excavation adjacent to the Geocomposite wall drain in accordance with the details shown on the Plans. Place solid pipe at 200-foot (61-meter) intervals with a minimum of 2 solid pipes at each bench excavation, joined to perforated pipe with "T" connections. Connect all joints securely. Place drainage aggregate to a level of 6 inches (152 mm) above the pipes without disturbing the pipe alignment. Wrap the plastic filter fabric over the drainage aggregate prior to backfilling with soil.

E. Backfilling and Placement of Geogrid Reinforcement

Place soil to be used as backfill material with the same lift and compaction requirements as normal embankment construction. Do not disturb the pipe alignment. Place layers of Type B geogrid reinforcement 4 feet (1.22 m) long beginning at a level 2 feet (600 mm) above the bottom of each bench, and at 1-foot (300 mm) intervals thereafter as each bench excavation is backfilled.

F. Markers

Mark each outlet end of the drainage pipe in accordance with Plan details.

G. Protection from Contamination

Protect all materials from contamination by foreign matter. In the event that the drainage aggregates, plastic filter fabric or Geocomposite wall drains become contaminated, remove the contaminated portion and replace with clean material at no additional cost to the Department. Placement of soil backfill over the fabric is incidental to the Work and is not considered to be contamination.

H. Type B Concrete Flume

After the slope is backfilled, construct a Type B concrete flume at each solid drain location as indicated on the Plans. Extend each flume from the topmost solid drain pipe to the bottom of the slope.

572.4 Measurement

Slope underdrains will be measured for payment by the linear foot (meter) of accepted perforated underdrain in place at each bench excavation. No separate measurement will be made for bench excavation, drainage aggregate, Geocomposite wall drain, solid drain pipe, connections, geogrid, plastic filter fabric, or backfill required by the Plan Details.

Additional depth bench excavation required beyond the limits of the Plan details and directed by the Engineer will be measured according to Subsection 205.4 of the Specifications.

No separate measurement will be made for disposing of any unsuitable material encountered. Replacement material will not be measured separately.

When the contract includes Item 210-Grading Complete, additional depth bench excavation required beyond the limits of the Plan details, and as directed by the Engineer, will be measured according to Subsection 210.4.C. of the Specifications. No separate measurement will be made for backfilling the additional depth bench excavation.

572.5 Payment

Slope underdrains will be paid for at the Contract Price per linear foot (meter), complete and in place. Payment is full compensation for excavation, furnishing all materials, including drainage aggregate, Geocomposite wall drain, solid drain pipe, perforated drain pipe, connections, geogrid and plastic filter fabric, backfill, placing all materials and for all labor, equipment, tools and incidentals necessary to perform the Work.

Payment for concrete flumes will be according to the Plans.

Additional depth bench excavation required beyond the limits of the Plan details, and as directed by the Engineer, will be paid for at the Contract Price per cubic yard for Unclassified Excavation.

When the contract includes Item 210-Grading Complete, additional depth bench excavation will be paid for according to Subsection 210.5.C, "Undercut Excavation".

Payment will be made under:

Item No. 572	Slope Underdrains	Per linear foot (meter)
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572.5.01 Adjustments

General Provisions 101 through 150.

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA**

SPECIAL PROVISION

Add the following:

Section 620—Temporary Barrier

620.1 General Description

This work provides for Method 1 and Method 2 temporary barrier systems.

620.1.01 Definitions

Method 1- Method of furnishing, placing, maintaining, moving, and reusing where required, and removing temporary barrier of the length and at the locations shown on the Plans. Method 1 barrier is not suitable on bridges where the distance from the centerline of the barrier to the free edge of the bridge deck is less than or equal to 6'-0" (1.8 m) measured normal to the barrier.

Method 2- Method of furnishing, placing, maintaining, moving, and reusing where required, and removing manufactured barrier of the length, and at the locations shown on the Plans. Method 2 barrier is to be used on bridges and bridge approaches where the distance from the centerline of the barrier to the free edge of the bridge deck is less than or equal to 6'-0" (1.8 m) measured normal to the barrier.

620.1.02 Related References

A. Standard Specifications

[Section 500—Concrete Structures](#)

[Section 501—Steel Structures](#)

[Section 511—Reinforcement Steel](#)

B. Referenced Documents

General Provisions 101 through 150

National Cooperative Highway Research Program (NCHRP) Report 350.

620.1.03 Submittals

Method 1 - Submit certification from the manufacturer that the proposed barrier and its interconnecting hardware replicates an NCHRP-350 "Test Level 3" approved documented in an acceptance letter from FHWA or certification that the barrier meets the requirements of Ga. Std. 4961. Submit all certification documents to the engineer prior to delivery of the barrier to the project.

Method 2 - Submit certification from the manufacturer that the proposed barrier and its interconnecting hardware replicates an NCHRP 350 "Test Level 3" approved documented in an acceptance letter from FHWA and that the barrier does not deflect more than 1'-0" (300mm) under NCHRP test conditions. Attach the acceptance letter stating that the proposed is in compliance with NCHRP 350 "Test Level 3" and

that the barrier meets the deflection criteria to the certification. Submit all certification documents to the engineer prior to delivery of the barrier to the project.

620.2 Materials

A. Method 1

Supply a temporary barrier.

Ensure that materials are in accordance with the manufacturer's recommendations, specifications, and details or that the materials meet the requirements of the Standard Specifications and Ga. Std. 4961.

B. Method 2

Supply a temporary barrier.

Ensure that materials used in the barrier are in accordance with the manufacture's recommendations, Specifications, and details.

620.2.01 Delivery, Storage, and Handling

A. General

Deliver, store, and handle barrier in accordance with the manufacturer's recommendations.

Repair damage to the barrier and its connections in accordance with the manufacturer's recommendations at no additional cost to the Department prior to acceptance for use by the Department.

620.3 Construction Requirements

620.3.01 Personnel

General Provisions 101 through 150.

620.3.02 Equipment

General Provisions 101 through 150.

620.3.03 Preparation

General Provisions 101 through 150

620.3.04 Fabrication

A. Method 1

Perform barrier fabrication as detailed on Ga. Std. 4961 or in accordance with the manufacturer's recommendations.

B. Method 2

Perform barrier fabrication in accordance with the manufacturer's recommendations.

620.3.05 Construction

A. General

Handle and transport units to prevent damage and/or as recommended by the manufacturer. When required, use units at one or more sites on the same project.

Ensure that the units are complete and in acceptable condition and located where designated on the Plans or directed by the Engineer before acceptance by the Department.

Use the Plan quantity of barrier effectively to complete The Work within the Contract time. If scheduling The Work requires additional barrier, furnish it at no additional expense to the Department.

Use only one section shape, length, and connection type in a single run of interconnected barrier.

B. Method 2

Rigidly attach the barrier to the bridge deck and extend it off the bridge a transition distance indicated in the Standard Plans.

Interconnect all barrier sections within each single run of barrier.

Use non-shrink grout to fill all holes remaining in permanent bridge decks after barrier is removed.

620.3.06 Quality Assurance

General Provisions 101 through 150.

620.3.07 Contractor Warranty and Maintenance

General Provisions 101 through 150.

620.4 Measurement

This work will be measured per unit {per linear foot (meter)} of accepted barrier delivered and used. The quantity shall be computed by multiplying the number of units by the length of each unit as per Standard 4961 or approved alternate, subject to the maximum amount specified in Subsection 620.3.05.

620.4.01 Limits

General Provisions 101 through 150.

620.5 Payment

This work is paid for at the Contract Price per linear foot (meter) of temporary barrier Method 1 or barrier Method 2 as designated complete in place. Payment includes fabrication, use, moving, reuse, and removal of the units.

No separate payment will be made for moving and/or reusing units during the work or for using additional units beyond the Plan quantity to facilitate the construction schedule.

No separate payment will be made for filling holes used to bolt Method 2 barrier to bridge decks.

The first 75 percent of the Contract Unit Price bid will be paid on the first monthly estimate following initial delivery, installation, and acceptance.

The remaining 25 percent will be paid when the Project is complete or when the material is no longer needed and removed from the Project, whichever applies.

Payment will be made under:

Item No. 620	Temporary Barrier, Method No. 1	Per linear foot (meter)
Item No. 620	Temporary Barrier, Method No. 2	Per linear foot (meter)

620.5.01 Adjustments

General Provisions 101 through 150.

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA
SPECIAL PROVISION**

Section 624—Sound Barriers

Delete Sub-section 624.2.B and substitute the following:

B. Type C

Use precast concrete panels that meet these requirements:

Class AA Concrete	Section 500
Reinforcing	AASHTO M 31/M 31M and M 32/M 32M
Piling-Galvanized Steel	Section 520 and AASHTO M 111/M 111M
Elastomeric Bearing Pads	Section 885

Use piling, bolts, and fittings that are hot-dip galvanized when the barrier rests on another concrete structure.

Delete Sub-section 624.3.F.2.e and substitute the following:

- e. Give the panels a Type III—Rubbed Finish on the upper surface (as cast) according to [Subsection 500.3.05.AB, “Finish Concrete.”](#) When an architectural finish is specified for one side of the barrier, provide a similar finish to the opposite side unless noted otherwise in the plans.

Delete Sub-section 624.3.F.5.c and substitute the following:

- c. Cast the panels on a steel surface with steel side forms. When an architectural finish is specified for one side of the barrier, provide a similar finish to the opposite side unless noted otherwise in the plans.

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA
SPECIAL PROVISION**

**Section 627—Mechanically Stabilized Embankment Retaining Wall-
Contractor Design**

Delete Subsection 627.2 and substitute the following:

627.2 Materials

Meet the requirements of [Section 626.2, “Materials”](#) of the Specifications.

Delete Subsection 627.3.03.B and substitute the following:

B. Wall Design

Use the following design criteria for a Contractor designed wall:

1. Provide one of the following wall systems:
ARES (Tensar Earth Technologies)
Reinforced Earth Wall (The Reinforced Earth Company)
Tricon Retained Soil Wall (Tricon Precast)
Stabilized Earth Wall (T&B Structural Systems)
2. Design the MSE Wall according to the current AASHTO Standard Specifications for Highway Bridges including interims. (Mechanically Stabilized Earth Wall Design – Section 5.8)
3. Design the MSE wall to account for all live load, dead load and wind load from all traffic barrier, lights, overhead signs, sound barriers and other appurtenances located on top and adjacent to the wall. Design MSE walls to account for all external forces. Also, design abutment walls for all horizontal and vertical loads applied by the bridge.
4. Assume responsibility for all temporary shoring that may be necessary for wall construction. Design the shoring using sound engineering principles.
5. Use permanent concrete wall facing panels that are at least 7 in (175 mm) thick.
6. Provide a minimum length of soil reinforcement of 10 feet (3 m) or seven-tenths (0.7) of the wall height, whichever is greater.
7. Ensure that the special wall backfill extends a minimum of 12 in (300 mm) past the end of the soil reinforcement.
8. Use the Architectural treatment of facing panels as indicated on the Department’s drawings.
9. Provide internal walls to allow for future widening if shown on the wall envelope. Ensure the internal walls have galvanized wire or concrete facing. Ensure as a minimum that the facing of the internal walls extend to the back limit of the MSE Wall Backfill for the permanent wall.

Section 627 – Mechanically Stabilized Embankment Retaining Wall-Contractor Design

10. Ensure the maximum panel area does not exceed 35 square feet (3.25 square meters).
11. Design the barrier for a 500 lbs. per linear foot (744 kilograms per linear meter) loading applied horizontally along the top of the barrier. The barrier shall be continuous or have a counterweight slab continuous over not less than four panels.
12. A Foundation Investigation Report may be available from the Geotechnical Engineering Bureau of the Department. The information contained in this report may be used by the Contractor to assist in evaluating existing conditions for design as well as construction. However, the accuracy of the information is not guaranteed and no requests for additional monies or time extensions will be considered as a result of the Contractor relying on the information in this report.
13. Ensure the following requirements are met:
 - The gutterline grade on the proposed top of wall submitted matches the gutter elevations required by the plans.
 - The top of coping is at or above the top of coping shown on the envelope.
 - The leveling pad is at or below the elevation shown on the wall envelope.
 - Any changes in wall pay quantities due to changes in the wall envelope are noted in the contractor's plans
 - All changes in quantities due to the proposed walls being outside the wall envelope (step locations, ending wall at full panel, etc.) are shown as separate quantities.
14. Ensure the minimum embedment of the wall (top of leveling pad) is at least 2 feet (600 mm). If the soil slopes away from the bottom of the wall, lower the bottom of the wall to provide a minimum horizontal distance of 10 ft (3 m) to the slope. [i.e. a 2:1 slope in front of the wall requires 5 ft (1.5 m) of embedment; a 4:1 slope in front of the wall requires 2.5 ft (750 mm) of embedment]
15. If the Department's review of the submitted plans and calculations results in more than two submittals to the Department by the Contractor, the Contractor will be assessed for all reviews in excess of two submittals. The assessment for these additional reviews will be at the rate of \$60.00 per hour of engineering time expended.

Delete Subsection 627.3.04 and substitute the following:

627.3.04 Fabrication

Meet the requirements of [Section 626.3.04](#) of the Specifications.

Delete Subsection 627.3.05 and substitute the following:

627.3.05 Construction

Meet the requirements of [Section 626.3.05](#) of the Specifications.

Office of Bridge Design

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA**

SUPPLEMENTAL SPECIFICATION

Section 632—Portable Changeable Message Signs

Delete Subsection 632.3 and substitute the following:

632.3 Construction Requirements

632.3.01 Personnel

General Provisions 101 through 150.

632.3.02 Equipment

Use Portable Changeable Message Sign (PCMS) meeting the requirements of MUTCD, Section 6F.55 Portable Changeable Message Signs and the following:

- A. Completed a full evaluation cycle (1-year) by National Transportation Product Evaluation Program (NTPEP).
- B. Passed NTPEP durability test.
- C. Has a control system with a keyboard to allow programming of user defined messages.
- D. Have primary and backup power sources.
- E. Capable of adjusting its brightness from daylight to night time conditions.
- F. Capable of displaying 3 lines of legend.
- G. Has a minimum reliability from its primary power supply for a minimum of 14 days for solar units (5 days for diesel units). Gasoline powered units not allowed.
- H. Message displayed on the sign is visible for 3000 feet (915 m) and legible for not less than 650 ft (198 m) during both daytime and nighttime operation.
- I. Is a self-contained unit including a control system with keyboard, primary and backup power source, mounting and transporting equipment (trailer mounted with all applicable lights and hardware).
- J. Bottom of message sign panel is capable of being raised a minimum of 7 feet above the roadway.
- K. Listed on [QPL 82](#) as maintained by the Office of Materials and Research or have a letter of approval from the Office of Materials and Research before the sign is used on any portion of the worksite.
- L. PCMS that remain the property of the Contractor may be either new or used provided the PCMS meets the requirements of this Subsection.
- M. In addition to the alphanumeric combinations, the signs should include the capability to display directional arrow messages. A PCMS may be used as an arrow board display panel provided the PCMS meets the size and display requirement of a Type C panel as defined by the MUTCD, Section 6F.55 Portable Changeable Message Signs.
- N. The PCMS has the following programmed as permanent messages:
 - 1) /KEEP/RIGHT/ /
 - 2) /KEEP/LEFT/ /
 - 3) /TWO WAY/ TRAFFIC/AHEAD/
 - 4) /ONE LANE/BRIDGE/AHEAD/
 - 5) /MERGING/TRAFFIC/AHEAD/
 - 6) /HEAVY/TRAFFIC/AHEAD/
 - 7) /BUMP/AHEAD/ /
 - 8) /PAINT/CREW/AHEAD/
 - 9) /LOOSE/GRAVEL/AHEAD/

Section 632—Portable Changeable Message Signs

- 10) /SURVEY/PARTY/AHEAD/
- 11) /ICY/BRIDGE/AHEAD/
- 12) /ROUGH/ROAD/AHEAD/
- 13) /DO/NOT/PASS/
- 14) /LOW/SOFT/SHOULDER/ /
- 15) /SHOULDER/DROPOFF/ /
- 16) VEHICLES/CROSSING/ROADWAY/
- 17) /DETOUR/AHEAD/ /
- 18) /MERGE/RIGHT/AHEAD/
- 19) /MERGE/LEFT/AHEAD/
- 20) /TRAFFIC/ACCIDENT/AHEAD/
- 21) /TRAFFIC/SLOWS/AHEAD/
- 22) /ROAD/NARROWS/AHEAD/
- 23) /LEFT/LANE/NARROWS/
- 24) /RIGHT/LANE/NARROWS/
- 25) /LANE/NARROWS/AHEAD/
- 26) /LEFT/LANE/ /
- 27) /RIGHT/LANE/ /
- 28) /LEFT/SHOULDER/ /
- 29) /RIGHT/SHOULDER/ /
- 30) /CLOSED/AHEAD/ /

- O. The PCMS is entirely mounted on a trailer that meets all of the requirements of the Georgia Vehicle Code. Additional trailer requirements:
1. The trailer and the components of the sign is designed to allow one person to perform all transporting and operating functions without assistance.
 2. The trailer is designed for unlimited on-highway travel at 70 mph (110 kph).
 3. The trailer has a minimum of four outrigger type leveling jacks, one at each corner of the trailer deck.
 4. The jacks are mounted to allow them to swivel into a locked position for secure storage during travel.
 5. The trailer and all mounted equipment are structurally adequate for unlimited normal operation in wind velocities up to 80 mph (130 kph).

632.3.03 Preparation

General Provisions 101 through 150.

632.3.04 Fabrication

General Provisions 101 through 150.

632.3.05 Construction

A. Utilization Requirements

1. When set up as a Pay Item in the Contract, utilize PCMS whenever any condition(s) exists that would require extra emphasis in warning motorists of a situation or at any location as directed by the Engineer. Furnish PCMS and have them available on a continuous basis.
2. Use PCMS on Interstate, limited access and multi-lane divided highways when any of these conditions exist:
 - a. Workers or equipment operating within 2 ft. (600 mm) of a travel lane without appropriate traffic control devices for positive barrier protection.
 - b. Excavation or other construction creates drop-offs adjacent to the edge of a travel lane and channelization devices are placed within the travel lane that is adjacent to the drop-off.
 - c. Material hauling in or out of a travel lane by hauling vehicles requires traffic to slow in the temporary traffic control zone.

Section 632—Portable Changeable Message Signs

- d. Traffic is delayed by pacing all lanes for short periods of time for placing bridge beams, overhead sign structures, blasting, etc.
 - e. Any time that divided highway traffic is required to operate as two-way traffic condition and traffic is not separated by a positive barrier system.
 - f. One mile in advance of lane closure, place PCMS on outside shoulder denoting appropriate lane closure one mile ahead.
3. Use PCMS on all other types of roadways according to the the traffic control plan or as directed by the Engineer.
 4. Locate the PCMS near the construction activity and display a message that is both concise and meaningful. Obtain the Engineer's approval for messages used on the PCMS.
 5. Include the location of the PCMS and any message to be displayed on the PCMS in the approved traffic control plan required in [Section 150-Traffic Control](#).
 6. For emergency situations, PCMS that are smaller in size and do not have all of the capabilities outlined in this Specification, may be used until a PCMS that meets these requirements can be located and placed in operation at the site.

The Engineer will determine when conditions and situations are to be considered emergencies and will regulate the length of time that non-specification PCMS may be used.

Provide the Engineer written notification when non-specification PCMS signs are in use on the work.

B. PCMS Phase Messages

1. Messages are displayed in preferably one phase but no more than two phases.
2. The first phase directs the motorist to take a specific action, such as MERGE/RIGHT, KEEP/RIGHT, OR REDUCE / SPEED.
3. The second phase, if necessary, is used to inform the motorist of road conditions such as LEFT/LANE/CLOSED; LANE/NARROWS/AHEAD; WATER/IN/ROAD; SHOULDER/DROP OFF; TRUCKS/IN AND/OUT.
4. Do not use messages such as USE/CAUTION; HAZARD/AHEAD; or DANGER which are confusing and give no guidance to the motorist. Also, do not use messages such as BUCKLE/UP or DRIVE/SAFELY which diminish the impact of important and relevant messages.

632.3.06 Quality Acceptance

General Provisions 101 through 150.

632.3.07 Contractor Warranty and Maintenance

Keep the units in good repair and neat and clean in appearance. If the unit fails, malfunctions, or is damaged, immediately repair the unit and furnish flaggers or other approved means to safely control the traffic until the units are back in service. Make repairs or replace the unit within 24 hours. Maintenance also includes periodically cleaning the units.

Office of Materials & Research

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA**

SUPPLEMENTAL SPECIFICATION

Section 636—Highway Signs

Delete Section 636 and substitute the following:

636.1 General Description

This work includes fabricating and installing highway signs according to the details on the Plans and the Manual on Uniform Traffic Control Devices.

636.1.01 Definitions

General Provisions 101 through 150.

636.1.02 Related References

A. Standard Specifications

[Section 500—Concrete Structures](#)

[Section 830—Portland Cement](#)

[Section 855—Steel Pile](#)

[Section 870—Paint](#)

[Section 910—Sign Fabrication](#)

[Section 911—Sign Posts](#)

[Section 912—Sign Blanks and Panels](#)

[Section 913—Reflectorizing Materials](#)

[Section 914—Sign Paint](#)

[Section 915—Mast Arm Assemblies](#)

[Section 916—Delineators](#)

[Section 917—Reflective and Nonreflective Characters](#)

B. Referenced Documents

Manual on Uniform Traffic Control Devices

636.1.03 Submittals

Before fabricating overhead panel type signs, submit to the Engineer the Shop Drawings to approve the sign bracing and method of attaching to sign supports.

Before driving piles, furnish a list of proposed pile lengths to the Engineer.

636.2 Materials

Ensure that materials meet the requirements of the following Specifications:

Section 636—Highway Signs

Material	Section
Sign Fabrication and Accessories	910
Steel Sign Posts and Bolts (Drive Type)	911.2.01
Galvanized Steel Structural Shape Posts	911.2.02
Delineator Posts	
Galvanized Steel	911.2.04.A.4
Aluminum "U" Flange	911.2.04.A.5
Wood	911.2.04.A.6
Flexible	911.2.04.A.7
Aluminum Sign Blanks	912.2.01
Extruded Aluminum Sign Panels	912.2.02
Reflective Sheeting	913.2.01
Silk Screen Lettering Paint	914.2.01
Steel Posts and Arms for Mast Arm Assembly	915.2.01
Guy Wires for Mast Arm Assembly	915.2.02
Center Mount Reflector	916.2.01
Demountable Characters with Reflective Sheeting	917.2.01
Fittings, bolts, nuts, washers, clips, molding, etc., for panel signs shall conform to the requirements shown on the Plans.	
Class A Concrete Footings for Signs	500
Piling	855.2.03
Portland Cement	830.2.01
Sign Paint, Enamel	870.2.03

636.2.01 Delivery, Storage, and Handling

General Provisions 101 through 150.

636.3 Construction Requirements

636.3.01 Personnel

General Provisions 101 through 150.

636.3.02 Equipment

General Provisions 101 through 150.

636.3.03 Preparation

General Provisions 101 through 150.

636.3.04 Fabrication

General Provisions 101 through 150.

636.3.05 Construction

A. Finished Signs

Ensure that the finished signs are clear cut and that the lines of letters and details are true, regular, and free of waviness, unevenness, furry edges or lines, scaling, cracking, blistering, pitting, dents, or blemishes.

Only one type of demountable characters (letters, numerals, symbols, and borders) is permitted on special roadside signs on each Project.

B. Erecting the Signs

1. Drive Type Posts

Drive type posts may be driven in place or placed in prepared holes.

a. Use driven posts only in firm and stable soil. If the soil is sandy or unstable, place each drive type post in a prepared dry hole of at least a 4 in (100 mm) diameter.

b. When placing posts in prepared holes:

1) Backfill the holes with a mixture of damp, clean friable soil and 8 percent by volume Portland cement.

2) Thoroughly tamp the mixture in place around the posts.

c. Erect posts vertically as deep and at an angle to the roadway as shown on the Plans or as directed.

d. Do not penetrate posts in the coastal plain region less than 4 ft (1.2 m) or 3 ft (1 m) for posts in the Piedmont and the Valley and Ridge Regions when no guard rail is present.

When erecting signs behind a guard rail, penetrate at least 3 ft (1 m) for posts 14 ft (4.2 m) or less long, or 4 ft (1.2 m) for posts over 14 ft (4.2 m) long.

2. Single-Plate Signs

Erect single-plate signs 9 ft² (0.84 m²) or less on one drive-type post unless otherwise specified on the Plans.

Erect single-plate signs greater than 9 ft² (0.84 m²) on two drive-type posts.

Leave enough distance between the two posts to fit the mounting holes in the sign plate.

3. Steel Posts for Mast Arm Assemblies

a. Erect steel posts for mast arm assemblies in a concrete foundation according to the Plans. Erect at the place, height, and angle to the roadway specified.

b. After curing the concrete foundation for at least 24 hours, securely fasten the specified signs into place on the mast arm.

4. Ground-Mounted Panel-Type Signs

a. Erect the supporting members of ground-mounted panel-type signs where shown on the Plans or as directed by the Engineer at the specified angle to the roadway.

b. Securely fasten the panels into place.

5. Milepost Signs

Erect milepost signs including posts as specified on the Plans.

6. Delineator Posts

Use delineator posts made of galvanized steel, aluminum, or an alloy that conforms to the requirements of [Subsection 911.2.04.A.4](#) or [911.2.04.A.5](#).

a. Erect the posts where shown on the Plans.

b. Mount reflectors for galvanized steel or aluminum posts on the flange side of the post.

c. When signs are attached to supports, torque the bolts to at least 20 ft-lbs (27 N•m).

7. Overhead Panel-Type Signs

Erect overhead panel type signs on sign supports where shown on the Plans or as directed by the Engineer.

a. Ensure that the bottom of the sign is 18 in (450 mm) above the top of the lighting fixture.

b. Ensure that the sign has ample bracing for mounting the sign support so that each sign can withstand 1 in (25 mm) of ice accumulated on the entire sign and wind pressures shown on the Plans.

Section 636—Highway Signs

- c. Ensure that the top of each sign is three degrees off perpendicular from the bottom of the sign. Use the three-degree slant to lean the sign toward the approaching traffic.

C. Foundations (for Special Roadside Signs)

Do not disturb the natural ground adjacent to a foundation more than necessary to construct the footing.

1. Excavate for the footings to the lines and elevations shown on the Plans or established by the Engineer. Do not disturb or loosen the foundation below these elevations.
2. Use forms of the necessary shape and dimensions to construct the footings to the lines and elevations shown on the Plans.
3. Cure the concrete foundations, constructed in conformance with [Section 500](#) and the Plan details, at least 7 days before erecting the sign.
4. Ensure that the minimum lengths of steel H piling used in the foundations of ground-mounting signs are accepted and meet the Plan penetration requirements.
The Plan quantity of steel H piling is shown for estimating purposes only; determine and provide the necessary lengths of piles.
5. Before driving the piles, furnish a list of proposed pile lengths to the Engineer.
 - a. Use full-length piles or built-up piles with a maximum of two splices that are made in the presence of the Engineer.
 - b. Furnish satisfactory identification for all piles or portions thereof.
6. When rock prevents the penetration required on the Plans, construct according to the notes and details shown on the Plans.
7. The minimum energy ratings required by [Section 520](#) for pile hammers will be waived for constructing ground-mounted sign supports. Jetting is not permitted.
8. Place required backfilling in layers no greater than 6 in (150 mm) thick and thoroughly compact it to the approximate density of the undisturbed soil in the area.

D. Sign Panels

Use extruded, panel-type aluminum. Ensure that the sign type used meets the requirements of [Subsection 912.2.02](#).

E. Legends and Borders

Place legends and borders according to [Subsection 917.2.01, “Demountable Characters”](#), with Type IX reflective sheeting.

636.3.06 Quality Acceptance

General Provisions 101 through 150.

636.3.07 Contractor Warranty and Maintenance

General Provisions 101 through 150.

636.4 Measurement

A. Type-1 or Type-2 Highway Signs

Type 1 or Type 2 highway signs with reflective sheeting of Type III, IV, or IX as specified on the Plans to be paid for are measured for payment by the actual number of square feet (meters) and fraction thereof of sign type and sheeting specified. The measurement includes providing the message and furnishing and placing signs complete and accepted. The Plan quantity will be the pay quantity.

B. Extruded Aluminum Panels

Extruded aluminum panels to be paid for are the number of square feet (meters) or portion of square feet (meters) furnished, including legend components, border material, fittings, nuts, washers, clamps, molding, etc., furnished, erected, completed, and accepted.

Section 636—Highway Signs

C. Galvanized Steel Posts

Galvanized steel posts, types 1, 2, 3, 4, 5, 6, 7, or 8 to be paid for are the actual number of linear feet (meters) and fraction thereof of the type specified, furnished, erected, completed, and accepted.

Galvanized steel to be paid for is the number of pounds (kilograms) furnished, erected, and accepted. Weights are computed from theoretical weights listed in the Plans for each post size. Base plates, connections, anchors, stub post, etc., are not measured for payment but are considered incidental to the Item.

D. Delineators

Delineators (reflectorized guide markers) to be paid for are the number of the type specified, including posts, rivets, and spacers, that are furnished, placed, and completed and accepted.

E. Mast Arm Assemblies

Mast arm assemblies to be paid for are the actual number furnished and erected, including concrete footing, sign, and post, completed and accepted.

F. Special Roadside Signs

Class A concrete for special roadside signs to be paid for are measured by the cubic yard (meter), neat measurement according to [Section 500.5 “Payment.”](#) No deductions are made for the volume of concrete displaced by steel piling, anchor bolts, or posts.

G. Portland Cement

Portland cement stabilized material used for backfilling holes is not measured for payment.

H. Steel H—Piling

Steel H—piling is measured for payment by the linear foot (meter) of accepted piling in place (signs), remaining in the completed work.

636.4.01 Limits

General Provisions 101 through 150.

636.5 Payment

Highway signs, galvanized steel posts, I-beam posts, delineators, mast arm assemblies, Class A concrete, and piling for signs are paid for at the Contract Unit Price for the various items. Payment is full compensation for furnishing and erecting the Item complete in place according to this Specification.

Separate payment will not be made for piling splices, the cost of cutting, or the cutoff portions. Pile cutoffs remain the Contractor’s property.

Piles eliminated due to authorized revisions will be paid for according to [Subsection 109.06, “Eliminated Items.”](#) These piles become Departmental property. Except for the above provision, no payment will be made for piles delivered to the Project that are not used in the work.

Payment will be made under:

Item No. 636	Highway signs, type 1 material, reflective sheeting type____,	Per square foot (meter)
Item No. 636	Highway signs, type 2 material, reflective sheeting type____,	Per square foot (meter)
Item No. 636	Galvanized steel posts, type ____	Per linear foot (meter)
Item No. 636	Galvanized steel structural shape posts	Per pound (kilogram)
Item No. 636	Highway signs, aluminum extruded panels, reflective sheeting type ____	Per square foot (meter)
Item No. 636	Plastic Flexible Delineator, type____	Per each
Item No. 636	Delineator, Type____	Per each
Item No. 636	Piling in place, signs, steel H, HP 12x53 (HP 310x79)	Per linear foot (meter)

Section 636—Highway Signs

636.5.01 Adjustments

General Provisions 101 through 150.

Office of Materials & Research

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA**

SPECIAL PROVISION

**SECTION 639 – STRAIN POLES FOR OVERHEAD SIGN AND SIGNAL
ASSEMBLIES**

Retain Sub-Section 639.2 as written and add the following sub-section:

Section 639 - Strain Poles for Overhead Sign and Signal Assemblies

D. Strain Poles for ATMS Applications

Provide poles for supporting CCTV, VDS, and microwave radar detection devices that meet the following design specifications:

- Designed to 80 mph AASHTO wind load requirements
- Limited to a live horizontal deflection at the top equal to or less than 1% of pole height in a 50 mph wind, with a design load of four static cameras and one movable camera.
- Torsional deflection limited to a 1 degree, maximum.

Install mounting brackets, as illustrated on the plans, that are galvanized steel and are compatible with the mounting design of the specified cameras and pan/tilt devices, and are affixed to the pole to prohibit rotation.

Install all wiring internal up to the camera mounting bracket with no external conduit on the pole.

Provide a weatherproof wiring access point or handhole on the pole.

OFFICE OF TRAFFIC OPERATIONS

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA
SPECIAL PROVISION**

Section 647—Traffic Signal Installation

Delete Section 647 and substitute the following:

647.1 General Description

This work consists of furnishing materials and erecting a traffic signal installation including all traffic signal equipment, poles, bases, wires and miscellaneous materials required for completion of the installation. Ramp Meters are defined as a form of traffic signalization and all general provisions for traffic signalization are applicable unless otherwise noted in the Plans and Specifications.

It also includes all test periods, warranties and guarantees as designated in subsequent sections, and response to maintenance and operational issues as described in subsequent sections.

Apply for, obtain and pay for all utility services, communications services to, and pole attachment permits required by all utility owners that are necessary for the signal installation and operation required in the Plans. The Contractor will be responsible for establishing utility services and ongoing monthly costs related to utility services until final acceptance of the signal project.

Upon completion of a successful “burn in” or operational testing period for the signal installation, the Contractor will be responsible for an orderly and uninterrupted transfer of these services and permits to the local government or other jurisdiction that will be responsible for subsequent maintenance and operation.

647.1.01 Definitions

General Provisions 101 through 150.

647.1.02 Related References

A. Standard Specifications

- [Section 106—Control of Materials](#)
- [Section 107—Legal Regulations and Responsibility to the Public](#)
- [Section 108 —Prosecution and Progress](#)
- [Section 150 —Traffic Control](#)
- [Section 500—Concrete Structures](#)[Section 501—Steel Structures](#)
- [Section 535—Painting Structures](#)
- [Section 615—Jacking or Boring Pipe](#)
- [Section 631—Changeable Message Signs](#)
- [Section 636 – Highway Signs](#)
- [Section 639—Strain Poles for Overhead Sign and Signal Assemblies](#)
- [Section 645—Repair of Galvanized Coatings](#)
- [Section 680—Highway Lighting](#)
- [Section 681—Lighting Standards and Luminaires](#)
- [Section 682—Electrical Wire, Cable, and Conduit](#)
- [Section 700—Grassing](#)
- [Section 755—Electrical Work](#)
- [Section 800—Coarse Aggregate](#)
- [Section 801—Fine Aggregate](#)
- [Section 832—Curing Agents](#)

Section 647 —Traffic Signal Installation

[Section 833—Joint Fillers and Sealers](#)
[Section 850—Aluminum Alloy Materials](#)
[Section 852—Miscellaneous Steel Materials](#)
[Section 853—Reinforcement and Tensioning Steel](#)
[Section 854—Castings and Forgings](#)
[Section 861—Piling and Round Timber](#)
[Section 870—Paint](#)
[Section 886—Epoxy Resin Adhesives](#)
[Section 910—Sign Fabrication](#)
[Section 911—Steel Sign Posts](#)
[Section 912—Sign Blanks and Panels](#)
[Section 913—Reflectorizing Materials](#)
[Section 915—Mast Arm Assemblies](#)
[Section 922—Electrical Wire and Cable](#)
[Section 923—Electrical Conduit](#)
[Section 924—Miscellaneous Electrical Materials](#)
[Section 925—Traffic Signal Equipment](#)
[Section 926 – Wireless Communication Equipment](#)
[Section 927 – Wireless Communication Installation](#)
[Section 935—Fiber Optic System](#)
[Section 936—CCTV System](#)
[Section 937—Video Detection System](#)
[Section 939—Communications & Electronic Equipment](#)
[Section 940—Navigator Integration](#)

B. Referenced Documents

National Electrical Manufacturers Association (NEMA) Traffic Control Systems Standards No. TS 1
NEMA Traffic Control Systems Standards No. TS 2
AASHTO Roadside Design Guide
The Manual on Uniform Traffic Control Devices (MUTCD), current edition
National Electrical Code
National Electrical Safety Code (NESC)
[GDT 7 Determining Maximum Density of Soils](#)
[GDT 24a Determining the Theoretical Minimum Dry Density of Soils or Soil Aggregates containing > 45% Retained on the No. 10 Sieve](#)
[GDT 24b Determining the Theoretical Minimum Dry Density of Soils or Soil Aggregates containing > 5% Retained on 2-Inch Sieve using a 5.5 Pound Rammer and a 12 Inch Drop](#)
[GDT 67 Family of Curves Method for Determining Maximum Density of Soils](#)

647.1.03 Submittals

The Contractor will submit to the Engineer, signal material specifications and technical data information on all materials proposed for use on the project.

Products appearing on the Qualified Products List (QPL) are exempt from normal submittal requirements. These products have been evaluated by the Office of Traffic Operations and have proven their capability of meeting the appropriate Georgia Department of Transportation Specification. Any of these products may be used without submitting catalogue cuts, sampling or pre-testing. The Contractor shall submit a letter to the Field Engineer, stating which QPL items they will use. The Field Engineer and/or department designee must ascertain that the construction item is the same material identified on the appropriate QPL and will acknowledge receipt of these items in the project diary or as required by the Construction manual.

Section 647 —Traffic Signal Installation

Written approval is required from the State Traffic Engineer or District Engineer prior to beginning any work on the traffic signal installation and /or installing the proposed on the work site.

A. Review

For all traffic signal, and Intersection Video Detection System (IVDS) material submittals, the Engineer's review of the material should be completed within forty five (45) days from the date of receipt of the submission unless otherwise specified. The State Traffic Engineer or District Engineer will advise in writing, as to the acceptability of the material submitted.

The State Traffic Engineer or District Engineer may determine that submitted equipment is approved, in which no further action is required. Or the item(s) may be partially or totally rejected due to specification compliance. In the event materials submitted for use are rejected the Contractor is required to re-submit materials, within fifteen (15) days of notification of material failure or rejection. Resubmittal of subsequent materials for review will be considered the start point of a new approval cycle as described.

All material submittals for fiber optic communications equipment system components; CCTV, VDS cameras, LED Changeable Message Signs (CMS) and other materials and equipment proposed for use on the project will be reviewed by the Department's Traffic Signal Electrical Facility (TSEF). The material review for ITS items will be completed as defined in [Section 935—Fiber Optic System](#), [Section 936—CCTV System](#), [Section 937—Video Detection System](#), and [Section 939—Communications & Electronic Equipment](#) unless otherwise specified. The State Traffic Engineer or District Engineer will advise in writing as to acceptability of materials to be used on the project.

The Department reserves the right to be reimbursed by the Contractor for reviewing any equipment and/or component submittals after a second submittal of equipment proposed for use on the project.

B. Submittal Costs

No separate measurement or payment will be made for submittal costs. All costs associated with reproduction of submittal material documents, samples and mailing expensed will be the responsibility of the Contractor and are not subject to reimbursement by the Department. All material, including equipment data sheets, samples or related equipment information become the property of the Department and will not be returned to the Contractor.

C. Steel Strain Pole, Concrete Strain Pole or Steel Pole Certification

Instruct the supplier or manufacturer of the strain poles or steel poles with traffic signal mast arms to submit a certification, including mill certificates to:

Department of Transportation
Office of Materials and Research
15 Kennedy Drive
Forest Park, Georgia 30297

Include the following in the certification:

- A statement that the items were manufactured according to the Specifications, including the Specification Subsection number
- Project number and P.I. number

Instruct the supplier or manufacturer to send copies of the transmittal letter to the Engineer.

Prepare Shop Drawings and related signal strain pole design calculations. Provide "bending moment at yield" to determine the foundation size according to the signal strain pole foundation drawings. Submit all Shop Drawings and related signal strain pole design calculations to the Engineer to be forwarded to the State Bridge and Structural Design Engineer for review and approval. Obtain written approval prior to pole fabrication and installation. Upon acceptance of the pole certification provide one copy of the design calculations and shop drawings to the agency responsible for maintaining the traffic signal installation.

Show all dimensions and material designations of the designs on the Drawings. See [Subsection 501.1.03](#) for the certification procedure for poles and anchor bolts.

D. Signal Item Certification

Submit four (4) copies of material catalog product numbers and descriptions to the Engineer. One copy of all submittals is to be provided to the maintaining agency. Reference the project number, P.I. number and Specification Subsection number for the following traffic signal items:

- Signal heads

- LED Signal Modules
- Mounting hardware
- Controllers
- Cabinet assemblies
- Battery Backup System (BBS)
- Detectors
- Monitors (conflict/IVDS)
- Cable
- Load switches
- Blank-out signs
- Lane use signals
- Preformed cabinet bases
- Other related signal equipment (including but not limited to Conduit, Pull boxes, Ground Rods, Enforcement Indications, etc.)

Submit the material organized in a three ring binder with sections labeled as bulleted above. Provide four separate binders each one identical.

- For ITS items (including but not limited to Dialup Modems Fiber Cable, Fiber Optic Modems, Ethernet switches, Intersection Video Detection System) provide a separate binder organized by sections that includes all ITS items. Refer to the submittal requirements in the appropriate GDOT Specification (including but not limited to [Section 935—Fiber Optic System](#), [Section 936—CCTV System](#), [Section 937—Video Detection System](#), and [Section 939—Communications & Electronic Equipment](#)).

E. Test Results Submittal

Submit the results of the testing of the following items to the Engineer. A copy of the test result submittals shall be provided to the maintaining agency.

- Loop Detector Testing
- Signal Cable Testing
- Interconnect Cable Testing
- Pre-emption Testing
- Controller and Cabinet Testing from Manufacturer (Including conflict monitor)
- Traffic Signal Monitor
- Any other operational testing required by the Engineer

F. Mast Arm Pole Chart

For locations with mast arm pole installations, submit a “Mast Arm Pole Chart” for review and approval by the State Bridge and Structural Design Engineer. The “Mast Arm Pole Chart” shall also include a sketch on an 8 ½ inch x 11 inch (216 mm x 279 mm) sheet of paper showing the following:

- Curb lines
- Location of mast arm pole based on utility information and field location verified by Contractor. (Final location of mast arm pole must meet the criteria for setback from the road as specified in the Roadside Design Guide by AASHTO and in the Standard Detail Drawings.
- Distance from both adjacent curbs to mast arm pole
- Distance along mast arm from pole to curb and from curb to each proposed signal head
- Directional arrow
- Street names
- Position of Luminaries

Label the sketched distances. Once this pole chart is approved, the Contractor shall use the distances measured to the proposed signal head locations when ordering the mast arm to ensure that the mast arm is fabricated with holes for signal head wiring in the correct locations.

647.2 Materials

647.2.01 Delivery, Storage, and Handling

A. State-supplied Equipment

For projects where traffic signal equipment is to be supplied by the Georgia Department of Transportation, obtain State-supplied traffic signal equipment from the Traffic Signal Electrical Facility (TSEF):

1. Contact the Engineer by phone or correspondence within one week after receiving the Notice to Proceed and arrange for a date, time and location to pick up the signal equipment and materials from the Traffic Signal and Electrical Facilities (TSEF) .
2. Sign GDOT's Warehouse Issue Request Form 592 to accept delivery of the State-supplied equipment from GDOT's Traffic Signal Equipment Warehouse. Initial Form 592 if equipment is received from a GDOT District Field Office.
3. Inspect the equipment to ensure that it is operating properly and perform any operational tests within ten (10) calendar days after receiving the equipment.
4. Before installation, and within ten (10) calendar days, certify to the Engineer in writing that the State-supplied equipment was received in good condition.
5. Notify the Engineer in writing if the State-supplied equipment is defective. The State Signal Engineer will replace the defective State-supplied equipment.
6. If no written dissent is received after ten (10) calendar days or if equipment is installed in the field, the Engineer will consider this equipment to be satisfactory and accepted.
7. The Contractor shall supply new in like and kind State approved equipment to replace State-supplied equipment that is damaged or lost.

B. Signal Equipment

See [Section 925](#) for signal equipment specifications.

The signal equipment, components, supplies, or materials used in traffic signal installation may be sampled and tested if not previously approved by the Department.

Test according to the Specifications and the Sampling, Testing, and Inspection Manual using one or more of the following methods:

- Have the Department use their own facilities.
- Have the supplier or manufacturer use their facilities with an authorized Department representative to witness the testing.
- Provide independent laboratory test results indicating compliance with Department Specifications referenced in [Subsection 647.1.02, "Related References"](#), of this document.
- When testing by the Department is required, supply the item to the Department. Acceptance of materials tested does not exclude further testing or waive warranties and guarantees required by the Specifications.

C. Cable

Use cable conforming to [Section 680](#), [Section 922](#), and [Section 925](#) and the appropriate IMSA, NEMA, or UL Specifications for the wire or cable.

Obtain pole attachment permits required by local utility companies or pole owners to allow joint use for signal cable, hardware, or other auxiliary devices.

D. Interconnect Communications Cable

1. Use fiber optic interconnect cable or spread spectrum radio for all new interconnected signal systems. See [Section 935](#) for fiber optic cable or spread spectrum information, specifications, marking and installation and testing techniques.
2. Use copper cable only as directed by the Engineer or where specifically shown in the Plans. Refer to [Section 647.3.05, "Construction"](#), of this document for installation.

E. Messenger Cable

The messenger is used to support signal cable indicated in the Plans as overhead cable. Use devices such as aluminum wrap, aluminum wire ties or lashings to attach the cable.

- Before erecting the messenger strand, determine the suspension strand length to span the distance between the poles.
- Run the messenger strand from structure to structure without splicing.
- The minimum allowable sag is two and one-half percent (2.5%) of the longest diagonal distance between the signal poles unless pole manufacturers specifications exceed 2.5%.
- Calculate attachment points for the messenger strand at the signal pole according to the Plan Detail Sheet.

F. Conduit on Structures

Use rigid metallic materials for all exposed conduit for cabling. Use galvanized rigid steel (GRS) conduit on the exterior of signal poles and other structures and to house signal conductors for the entire length from the weather head on the pole to the interior of the cabinet or to the pull box and ground conduit using an approved grounding bushing. (see Subsection 647.3.05V).

647.3 Construction Requirements

Refer to [Subsection 107.07](#) of the Specifications regarding proper conduct of The Work.

647.3.01 Personnel

For the definition of a qualified electrician, see [Subsection 755.1.01](#).

647.3.02 Equipment

Use machinery such as trucks, derricks, bucket vehicles, saws, trenchers, and other equipment necessary for the work and approved by the Engineer prior to installation operations.

647.3.03 Preparation

Utility Permits

A. Application

Apply for, obtain, and pay for utility services and pole attachment permits for signal operation, traffic signal communications including standard telephone service and DSL communications as required in the Plans.

B. Maintenance

The Contractor will be responsible for establishing utility services and ongoing monthly costs related to utility services until Final Acceptance of the signal(s) installation, or in the event of multiple installations, the Contractor will be responsible for utility costs until overall project acceptance. After Final Acceptance, the Contractor will provide an orderly transfer these services and permits to the local government or jurisdiction responsible for maintenance and operation. Ensure that the transfer does not interrupt service.

C. Utility Location

1. Adjustment

Prior to ordering signal poles, locate utilities and adjust the location of poles, where necessary, to minimize utility conflicts. Obtain approval from the District Traffic Engineer for any deviation from the Plans.

Determine the final length of mast arms based on any field adjusted pole locations. Final location shall be approved by the District Traffic Engineer.

2. Clearance

When installing aerial cable of any type, it is the Contractor's responsibility to ensure that overhead clearance and separation requirements conform to local utility company standards, the NEC and the NESC. Refer to the Standard Details Drawings for further information on utility clearances.

3. Pre-emption

When traffic signal pre-emption is used, coordinate with the railroad, fire department or any other agency that uses pre-emption to obtain pre-emption output and route output cable to the signal controller operating the intersection to be pre-empted. It is the Contractor's responsibility to obtain all permits and approval for crossing at grade or grade separated railroad facilities.

647.3.04 Fabrication

General Provisions 101 through 150.

647.3.05 Construction

A. Acquiring and Disposing of Equipment

Do not modify the signal equipment, design, and operation without the District Traffic Operations Engineer's written approval.

All traffic signal equipment removed or replaced shall be returned to District Traffic Signal Shops unless otherwise noted in the Plans or as directed by the Engineer or District Signal Engineer. All materials not returned to the District Signal shop shall be the responsibility of the Contractor to remove and dispose.

B. Traffic Signal Equipment Modification and Removal

Upon the Department issuance of Notice to Proceed any existing traffic signal equipment, responsibilities for maintenance, operations and response to traffic signal malfunction become the responsibility of the Contractor and provisions of Subsection 647.3.07, "Contractor Warranty and Maintenance", apply.

1. Remove existing signal equipment that is not used in the final installation when the new signal equipment is operational.

Carefully remove equipment to minimize damage and retain it in its original form. This equipment may include:

- Strain poles including the foundation down to 3 feet (900 mm) below ground level finished grade
- Timber poles
- Traffic signal cabinets including contents, cabinet base and work pads
- Original signal heads including span wire support
- Other equipment not retained in the final installation

Ensure that unused equipment is secured and disposed of in accordance with all Environmental Protection Agency regulations and Department instructions.

2. If the Plans specify delivery of salvaged equipment to a Department facility, provide an inventory list and arrange a mutually agreeable delivery time with the District Signal Engineer twenty-four (24) hours in advance.
3. Replace traffic signal equipment that the District Signal Engineer determines has been damaged or destroyed during installation or modification of the traffic signal, at no expense to the Department. Replace with new material.
4. If the Engineer finds that the existing material shown in the Plans to be relocated is unsatisfactory, replace with new material. The costs will be paid for as Extra Work. Include the removal costs of all equipment, including salvaged equipment, in the cost of the overall bid price submitted.
5. Remove old signal heads by the end of the day that the new signal equipment is placed in operation. Remove all other signal equipment within seven (7) days after operations of the newly installed equipment.

C. Auxiliary Cabinet Equipment

Provide auxiliary cabinet equipment or special purpose equipment with connecting harnesses, if necessary, or as shown in the Plans or Standard Detail Drawings.

1. Install the equipment in its associated cabinet. Extraneous wiring may be necessary to install the equipment. Additional cabling shall be enclosed in rigid, galvanized conduit and neatly secured.
2. Connect the auxiliary equipment to its cable harness, or insert it in premounted racks or sockets.

D. Signal Controllers

Furnish and install approved microprocessor controllers at the locations shown in the Plans or as directed by the Engineer. All equipment furnished shall comply with [Section 925,"Traffic Signal Equipment"](#).

1. Identify the controller and other auxiliary equipment by model and revision numbers. These numbers shall agree with previously approved catalog submittals.
2. Assemble the controller, cabinet, and auxiliary equipment to provide the operational sequence shown in the Plans and future operations specified. Ensure the controller functions as a unit with the cabinet assembly.
3. Ensure controller and auxiliary equipment are provided AC power from receptacles marked for controller power.

4. The Department will provide controller firmware. The Contractor shall provide the controller to the Department. The Department will load the firmware into the controller and notify the Contractor that the controller is ready to be picked up. If the controller is purchased with applications firmware, ensure that the firmware provided is the current Department licensed version of firmware including “boot code”. Current firmware version shall be at the date of application ” turn on” .
5. Unless otherwise specified in the Plans or directed by the Engineer, thirty days prior to installation of equipment the Contractor shall deliver the controllers to and pick up the controller from the District Signal Engineer. The Department shall have 30 work days to load the controller firmware starting from the date the Contractor delivered the controllers to the Department.
6. For 2070 signal controllers used for Ramp Metering ensure the Watchdog Timer “Muzzle Jumper” is selected on the field input/output module. This is required for operating with a 208 monitor.

E. Cabinet Assembly

1. Location

The cabinet should be located in accordance with the Plan location, however if the cabinet location needs to be moved, choose a location that:

- a. Protects maintenance personnel from vehicles when servicing the equipment
- b. Allows the front panel door of the controller to open away from the intersection for view of signal indications while servicing or performing cabinet work.
- c. Does not block a sidewalk or passageway and complies with Federal regulations for Americans with Disabilities Act (ADA) clearance requirements.
- d. Is located away from the roadway or curb line to prevent vehicular damage to the cabinet.
- e. Is not located within drainage areas or installed in areas likely to collect and hold surface water.
- f. Relocate the cabinet to avoid conflicts from proposed reconstruction projects, commercial driveways, etc. within the right-of-way at the Engineer’s discretion.

2. Erection

Install and level traffic signal controller cabinets at locations shown in the Plans and/or as directed by the Engineer.

- a. Install cabinets to conform to the Standard Detail Drawings. Install pole or base-mounted as indicated in the Plans. Cabinet base shall not extend more than 9 inches above final grade.
- a.
- b. Seal base-mounted cabinets to their base using silicone based sealer. Pliable sealant used shall not melt or run at temperatures as high as 212 °F (100 °C).
- c. Use prefabricated bases and work pads
- d. Install technician pad in front and rear of the controller cabinet door and if applicable in front of battery backup cabinet door. See Standard Details for pad information.
- e. Close all unused conduit in the controller base with a PVC cap sized appropriately. Do not permanently affix the conduit cap to the conduit. Seal those conduits used for signal cable with a pliable sealant to prevent moisture and insects from entering the cabinet via the conduit.

3. Field Cabinet Wiring

All wiring shall be neat and secured and comply with NEC, NEMA, and [Table 647-1](#), [Table 647-2](#), [Table 647-3](#), [Table 647-4](#), [Table 647-5](#), and [Table 647-6](#) of this Specification.

- a. Cut field cabinet wiring to the proper length and organize it in the cabinet. Wire lengths should be slack (minimum 10 feet) allowing for future modifications.
 - Use at least No. 6 AWG wire for the conductors between service drop and AC+ and the AC- terminals.
- b. Do not mount electrical meter to the cabinet. Submit ”power pedestal” or other method of providing location for mounting to the Engineer.
- c. Label all field terminals and conductors so as to identify the specific field input.
- d. Crimp terminal connections to conductors with a ratchet-type crimping tool that will not release until the crimping operation is completed.
- e. Do not use splices inside the controller cabinet, base, or conduit.

- f. Do not use solid wire, except grounding wire.
- g. Supply the cabinets with cabinet wiring diagrams, schematic drawings, pin assignment charts, and manuals for circuits and components. Store these documents in the cabinet in a resealable, weatherproof container.
- h. Ramp Metering requirements. The typical Ramp Meter layout is shown below (for information only):

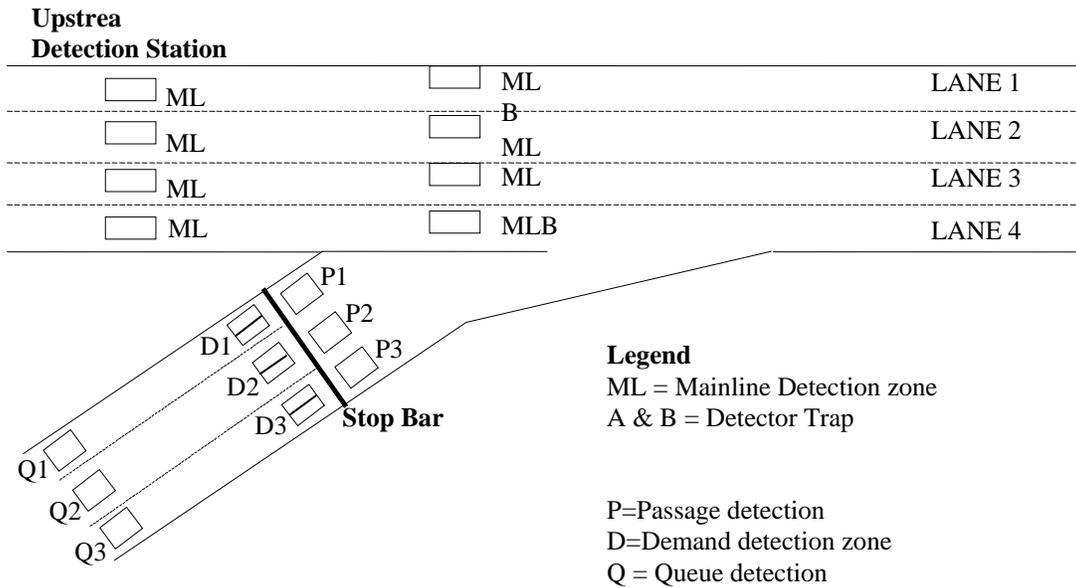


Figure 647-1 Typical Ramp Metering Layout

F. Signal Monitors

Furnish signal monitor equipment as follows,

1. Mount signal monitors in a rack with appropriate connectors to attach to the wiring harness.
2. Program the monitor according to the signal operation indicated in the Signal Plans before placing the installation in flash or stop-and-go operation. Provide any signal monitoring programming tools required to program the monitor to the maintaining agency.
3. Configure and equip the signal monitor to monitor all red signal indications. Ensure that the red output for unused or vacant load bays or output slots is jumpered to 120 V AC+.
4. For ITS Cabinets configure the CMU and AMU.
5. For Ramp Metering Cabinets mount model 208 monitor in rack and provide the necessary programming required for the Ramp Meter operation as shown in the Plans.

G. Power Disconnect

Install a power disconnect box at each intersection as shown in the Standard Detail Sheets. Ensure the power disconnect is installed at the top of the cabinet pole. Install service cables from disconnect box and terminate as specified on the controller cabinet-wiring or battery backup diagram.

H. Flashing Beacon

Furnish and install the flashing beacon controller at the locations shown in the Plans and/or as directed by the Engineer. Install it as a complete unit (solid state flasher and cabinet with time clock, if applicable) and ensure that it conforms to this Specification.

I. Loop Detector Systems

Install and test loop detector systems according to NEMA Standards Publication TS 1-1983, Section 15, Inductive Loop Detectors, subsequent revisions (except as shown in the Plans), Details, notes, and this Specification.

Ensure that loop detectors are complete and fully operational before placing the signal in stop-and-go operation.

1. General Installation Requirements

Each loop must consist of at least two turns of conductor, unless otherwise shown in the Plans or this Specification. Do not place a portion of the loop within 3 feet (1 m) of a conductive material in the pavement such as manhole covers, water valves, grates, etc.

- a. Install pull boxes, condulets, and conduits before beginning loop installation.
- b. Ensure that the ambient pavement surface temperature in the shade is at least 40 °F (5 °C) before cutting roadway and placing sealant into saw cuts.

2. Loop Saw Cuts

- a. Outline the loop on the pavement to conform to the specified configuration.
- b. Ensure each loop has a separate saw cut with a minimum distance between saw cuts of 6 inches.
- c. Install the detector loop in a sawed slot in the roadway surface deep enough to provide at least 3 inches (76 mm) of sealant cover.
- d. Ensure that the slot is at least 0.25 inches (6 mm) wide for stranded No. 14 AWG loop wire, THWN, XHHW, or XLPE, and at least 0.31 inches (7 mm) wide for polyethylene or PVC encased No. 14 AWG loop wire.

At the intersection of the slots, drill a 2 inch (51 mm) diameter hole or make miter saw cuts in the pavement. Overlap miter saw cuts at the intersection of saw cuts so that the slots have a full-depth and smooth bottom. Prevent the wire from bending sharply.

Do not install detector loop wire unless sawed slots are completely dry and free of debris. Pressure wash the slot to guarantee adhesion of the loop sealant. Use compressed air to thoroughly dry the sawed slot.

Install the loop wire starting at the nearest pull box or condulet, around the loop for the specified number of turns, and back to the pull box or condulet.

NOTE: Loop wire from the street is to be spliced in condulets or pull boxes only.

Refer to table 647-9 for the number of turns for Quadrupole loops. Refer to table 647-8 for the number of turns for) Bipole loops. Bipole loops require at least three (3) turns.

- e. Press the wire in the slot without using sharp objects that may damage the jacket.
- f. Hold the loop in place every 5 feet (1.5 m) with 1 inch (25 mm) strips of rubber, neoprene, flexible tubing, or foam backer rod as approved by the Engineer.
- g. Leave the hold down strips in place when filling the slot with loop sealant.
- h. Where encased loop wire is used, apply a waterproof seal to the ends of the polyethylene tubing that encase the wire to prevent moisture from entering the tube.
- i. Where the loop wires cross pavement joints and cracks, protect the loop wires using the method specified in “Traffic Signal Details” in the Plans. When crossing expansion joints drill a 2 inch diameter hole minimum 3 inches deep, or to bottom of saw cut. Do not install loop wires in an expansion joint.
- j. Twist Loop Lead-in 3 turns per foot.

3. Loop Sealing

After successfully testing each loop, fill the slots with sealant to fully encase the conductors.

- a. Seal the slot within one hour of cutting slot.
- b. Ensure that the sealant is at least 3 inches (75 mm) thick above the top conductor in the saw cut.
- c. Apply the sealant so that subsequent expansion does not extend the sealant material above the pavement surface.
- d. In case of accidental spill, before the sealant sets, remove surplus sealant from the adjacent road surfaces without using solvents or epoxy sealants.
- e. When the Engineer determines that the loop sealant can accommodate traffic but the surface is tacky, dust the sealer on the pavement surface with cement dust before opening the roadway to traffic.

- f. Dispose of the solvents used to clean loop installation equipment according to the manufacturer's specifications and local, State, and Federal regulations.

4. Loop Connections

Connect loop conductors to a shielded lead-in cable that runs from the pull box adjacent the pavement edge or conduit to the detector hook-up panel in the controller cabinet, unless otherwise specified in the Plans.

- a. Use continuous (no splices) shielded lead-in cable from the pull box or conduit to the cabinet input file terminal. Do not ground the shield in the loop lead-in cable at the cabinet.
- b. Connect each loop to an individual detector channel as specified in the Plans.
- c. If the Plans specify that two or more loops will be operated on the same detector channel or detector amplifier unit, wire them in series to their loop lead-in at the pull box or conduit.
- d. Use series-parallel connections when series connections do not meet the manufacturer's specified operating range for the detector amplifier unit.
- e. Make weather-tight and waterproof splices as detailed on the Plan Standard Detail Sheets. Make loop splices to loop lead-in cable only after the detector system has been tested and demonstrated under traffic conditions to the Engineer's satisfaction.

5. Loop Maintenance

Locate all existing loops, determine the operational status of all loop assemblies, and notify the Engineer prior to commencing loop construction activities at the intersection.

Maintain all existing, operational loops, unless otherwise notified by the Engineer. Repair of an existing loop that is non-operational prior to beginning work will be considered as extra work.

Locate points of conflict between new loops and existing loops, and install all new loops and saw cuts so as not to cut existing loop lead-ins and loop wires that are to be retained.

If an existing operational loop that is not scheduled for replacement fails during the construction time frame, notify the Engineer and complete the replacement of the damaged loops immediately.

The Engineer may grant a twenty-four (24) hour period to repair the loops if their operation is not critical. All costs associated with the replacement of the loops damaged during construction shall be charged and paid for by the Contractor.

J. Pedestrian Push Button

Install the push button with a pedestrian instruction sign as illustrated on the Department's Standard Detail Sheets and according to the Plans.

1. Place the pedestrian buttons as shown on the Signal Plan Sheet and within 10 inches of sidewalk or concrete landing pad. Position the pedestrian button to correspond to the appropriate signal phase. Locate pedestrian buttons perpendicular to the appropriate signal indication and signal phase, and as field conditions require.
2. Place the center of the buttons between 38 inches (0.965 m) and 42 inches (1.05 m) above the sidewalk or ground level.
3. Seal all openings to prevent moisture from entering the pushbutton.

K. Cable

Install and connect electrical cable to the proper equipment to produce an operating traffic signal system. Use stranded copper cable conforming to [Section 925](#).

Install wiring in accordance with IMSA, NEMA, UL, and the Department's Traffic Signal Wiring Standards, shown in [Tables 647-1](#), [647-2](#), [647-3](#), [647-4](#), [647-5](#), and [647-6](#) of this Specification.

In addition to the information provided below, see [Section 682](#), [Section 922](#), and [Section 925](#) for cable equipment and installation specifications.

Table 647-1 Vehicular Signals Georgia DOT Wiring Standards			
Signal Indications	3-Section Signal Heads Seven Conductor Cable		5-Section Signal Heads Seven Conductor Cable
	Phases 2, 4, 6, and 8	Phases 1, 3, 5, and 7	Phases 1/6, 2/5, 3/8 & 4/7
Red	Red Wire		Red Wire
Yellow	Orange Wire		Orange Wire
Green	Green Wire		Green Wire
Red Arrow		White Wire with Black Tracker	
Yellow Arrow		Black Wire	Black Wire
Green Arrow		Blue Wire	Blue Wire
Neutral	White Wire	White Wire	White Wire

Table 647-2 Vehicular Loop Detectors Georgia DOT Wiring Standards				
Detectors	Phases 3, 4, 7, and 8 Presence Loops		Phases 2 and 6 Setback Pulse Loops and Phases 1 and 5 Presence Loops	
	Loop Wires	Shielded Loop Lead-in Cable, 3 Pair	Loop Wires	Shielded Loop Lead-in Cable, 3 Pair
Right Curb Lane	Red Wire	Red/Black Pair (1)	Red Wire	Red/Black Pair (1)
Second Lane	Green Wire	Green Black Pair (1)	Green Wire	Green Black Pair (1)
Third Lane	White Wire	White/Black Pair (1)	White Wire	White/Black Pair (1)
Fourth Lane	Red Wire	Red/Black Pair (2)	Red Wire	Red/Black Pair (2)
Fifth Lane	Green Wire	Green/Black Pair (2)	Green Wire	Green/Black Pair (2)
Sixth Lane	White Wire	White/Black Pair (2)		
First Left-Turn Lane			Red Wire	Red/Black Pair (3)
Second Left-Turn Lane			Green Wire	Green/Black Pair (3)

Table 647-3 Pedestrian Signals Georgia DOT Wiring Standards		
Signal Indications	2-Section Signal Heads Seven Conductor Cable	
	Phases 2 and 6	Phases 4 and 8
Don't Walk	Red Wire	White Wire with Black Tracker
Walk	Green Wire	Blue Wire
Neutral	White Wire	White Wire

Table 647-4 Pedestrian Detectors Georgia DOT Wiring Standards		
Push Buttons	3 Pair Shielded Cable	
	Phase 2 and 6	Phase 4 and 8
Call	Green and Black Pair	Red and Black Pair

NOTE: Do not use aluminum cable.

Table 647-5 Ramp Meter Signals Georgia DOT Wiring Standards	
Signal Indications	3-Section Signal Heads Seven Conductor Cable L1,L2,L3
Red	Red Wire
Yellow	Orange Wire
Green	Blue Wire
Neutral	White Wire

Table 647-6 Ramp Meter Loop Detectors Georgia DOT Wiring Standards				
	Demand Detector Loops		Queue Detector Loops	
	Loop Wires	Shielded Loop Lead-in Cable, 3 Pair	Loop Wires	Shielded Loop Lead-in Cable, 3 Pair
Lane 1	Red Wire	Red/Black Pair (2)	Red Wire	Red/Black Pair (1)
Lane 2	Green/Wire	Green Black Pair (2)	Green Wire	Green/Black Pair (1)
Lane 3	White Wire	White/Black Pair (2)	White Wire	White/Black Pair (1)
	Passage Detector Loops		Mainline Detector Loops (if used)	
	Loop Wires	Shielded Loop Lead-in Cable, 3 Pair	Loop Wires	Shielded Loop Lead-in Cable, 3 Pair
Lane 1	Red Wire	Red/Black Pair (3)	Red Wire	Red/Black Pair (4)
Lane 2	Green Wire	Green/Black Pair (3)	Green Wire	Green/Black Pair (4)
Lane 3	White Wire	White/Black Pair (3)	White Wire	White/Black Pair (4)

I. Signal Cable for Vehicular Signal Heads and Pedestrian Heads

Install cable for signal heads and pedestrian heads as follows:

1. For vehicle signal heads, install one 7-conductor signal cable for each intersection approach from the controller cabinet to the through-signal head on each approach as directed by the engineer. From this leftmost signal head, install a 7-conductor signal cable to each of the other signal heads on the same approach in sequence.
2. For pedestrian signal heads, install one 7-conductor signal cable from the controller cabinet to each pedestrian head installation location to operate either one or two pedestrian heads.
3. Make a minimum 1 foot (300 mm) diameter 3 turn weather drip loop as shown in the Standard Detail Drawings in the Plans at the entrance to each signal head.
4. Neatly tie signal cables leaving a structure or weatherhead to enter a signal fixture. Tie the cables to the messenger cable as illustrated in the Standard Detail Drawings.
5. For Ramp Meter signal heads install one 7-conductor signal cable for each lane of the Ramp Meter operation from the controller cabinet .

M. Interconnect Communications Cable

Use fiber optic interconnect cable as specified in the Plans for all new interconnected signal systems. See Section 935 for fiber optic cable information, specifications and installation and testing techniques. Install interconnect communications cable as follows:

1. Provide support for the interconnect cable on new or existing utility poles or signal poles; install underground in conduit.
2. Use fiber optic standoff brackets as needed to prevent damage from poles, trees and other structures.
3. Pull cables with a cable grip that firmly holds the exterior covering of the cable.
4. Pull the cables without dragging them on the ground, pavement or over or around obstructions. The Engineer will inspect and approve the cable prior to installation. Use powdered soapstone, talc, or other approved inert lubricants to pull the cable through the conduit.
5. When using a separate messenger cable, spirally wrap the communications cable with a lashing machine according to the IMSA-20-2 Specifications.
6. Do not splice outside the signal cabinet except at the end of full reels of 5,000 feet (1500 m).
7. Ensure that splice points are near support poles and accessible without closing traffic lanes.
8. Unless drop cable assemblies for communications are used, loop the cable in and out of the control cabinets. Coil and tie 10 feet (3 m) of cable in the controller cabinet foundation. Tape the cable ends to keep moisture out until the terminals are attached.
9. Prevent damage to the cable during storage and installation.

NOTE: Do not allow anyone to step on or run over any cable with vehicles or equipment.
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N. Loop Detector Lead-in Cable

Use 3-pair shielded lead-in cable in compliance with [Section 925](#) and manufacturer's recommendations for Detector loop lead-in installed for loop detectors. Ensure the three pair has 3 separate distinguishing colors. Use a shielded lead-in cable connecting the loop to the detector hook-up panel in the controller cabinet, unless otherwise specified in the Plans. Provide a separate 3- pair for each phase or future phase.

1. Splice the loop detector wire to a shielded loop detector lead-in cable in a pull box adjacent to the loop detector installation.
2. Use continuous (no splices) shielded lead-in cable from the pull box or conduit to the cabinet input file terminal. Do not ground the shield in the loop lead-in cable at the cabinet.
3. Connect each loop to an individual detector channel as specified in the Plans.
4. Each detection loop shall be connected to the control cabinet via separate lead-in pair.
5. Set back loops with aerial loop leads to the control cabinet shall be supported by 1/4 inch messenger cable with no splices between the control cabinet and the initial point of aerial attachment.
6. Make weather tight and waterproof splices between lead-in and loop wire. Loop installation may be approved only after the detector system has been tested and demonstrated under traffic conditions to the Engineer's satisfaction, during the Operational Test Period.

O. Pedestrian Push Button Lead-in

Use 3-pair shielded lead-in cable compliant with [Section 925](#) for pedestrian push buttons. Install one 3-pair shielded lead-in cable to each pedestrian push button station(s) location to operate either one or two push buttons. Do not ground the shield for the push button lead-in cable at the controller cabinet. Do not use the same 3 pair cable for loop and pedestrian detectors.

P. Messenger Cable, Stranded-Steel

Set messenger strands so that the height conforms to the clearances on the Standard Detail Drawings. Lash cables to messenger cable or use lashing rods (Subsection 925.2.43). If lashing rods are used use lashing rods sized for the cables and messenger strand. Only use lashing rods that are of the same material as the messenger strand. Lashing wire shall only be used to support aerial loop lead-in and fiber optic.

1. Drill wood poles to receive the eye bolts so that the span wire and eyebolt at each connection form a straight angle.
2. Never pull or strain the messenger on the eye bolt to an angle of variance greater than ten degrees (10°).
3. Attach down guy wires to guy hooks. Use a minimum 3/8 inch messenger cable for down guys. Never attach them directly to the eye of an eyebolt.
4. Ensure that messenger strand clearances conform with local utility company Standards.
5. Make stranded messenger cable attachment points with the appropriate size strand vises or 3 bolt clamps. Stranded steel messenger cable is not paid for separately under this Specification.
6. Use minimum 1/4 inch messenger cable.
7. Use standoff brackets as needed to prevent damage from poles, trees or other structures.

<p>NOTE: Never splice messenger cable between structures or stand off brackets.</p>
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Q. Underground Cable for Signal Circuits

Underground cable for signal circuits includes cable, with conduit, as shown in the Plans. Install cable under existing pavement or surfaced shoulder, according to [Subsection 680.3.05](#).

1. Cable in Conduit
Pull cable into conduits as follows:
 - a. Pull cables into conduits without electrical or mechanical damage. Pull cables by hand only. The use of trucks or other equipment is not permitted, unless approved by the Engineer. If mechanical pulling is approved, do not exceed the manufacturer's tension rating for the cable.
 - b. Pull cables with a cable grip that firmly holds the exterior covering of the cable.
 - c. Use powdered soapstone, talc, or other inert lubricants to place conductors in conduit according to manufacturer's recommendations.
 - d. Handle and install the conductors to prevent kinks, bends, or other distortion that may damage the conductor or outer covering.
 - e. Pull all cables in a single conduit at the same time. When pulling cables through hand holes, pole shafts, etc., use a pad of firm rubber or other material between the cable and the opening edges to prevent cable damage.
 - f. When installing cable in conduit with existing signal cable circuits remove all existing cables and pull them back into the conduit with the new cables.
 - g. The distance between pull boxes in a run of conduit shall not be greater than 100 feet (30 m), unless otherwise shown in the Plans or approved by the Engineer or District Signal Engineer, with the exception of fiber optic cable.
 - h. The distance between pull boxes in a run of conduit for fiber optic cable shall not exceed 750 feet (225 m), unless otherwise shown in the Plans or approved by the Engineer. Identification tape and tone detection wire shall be used for fiber optic cable in conduit. All unused conduit shall have a continuous pull cable installed between pull boxes.
2. Splices

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Required splicing shall be performed according to the National Electric Code; use materials compatible with the sheath and insulation of the cable.

Insulate required splices with electrical insulation putty tape, plastic, pressure sensitive, all-weather 1.5 mil (0.038 mm) electrical tape in accordance to standard details.

- a. Make the spliced joints watertight.

Note: Splice detector wires to shielded loop detector lead-in at pull boxes located immediately after the loop wire leaves the roadway. No splices will be permitted in shielded loop detector lead-in cable from this point to the controller cabinet.

R. Conduit and Fittings

Install conduit by type (GRS, HDPE, PVC) as shown in the Plans and the Standard Detail Drawings. Refer to the NEC, for conduit full percentages.

Separate the power cable to the controller cabinet from all other cables in its own 1 in (25 mm) galvanized rigid steel conduit except inside poles. Ensure that conduit conforms to [Section 682](#), [Section 923](#) and [Section 925](#) with the following addition:

- Use flexible conduit only where shown in the Details or as directed to do so in writing by the District Signal Engineer.

Use the conduit size specified in the Plans, unless otherwise directed by the Engineer. Obtain written approval from the Engineer prior to installing conduit other than the size specified in the Plans.

All 2 inch (50 mm) conduit elbows shall be “sweep” type. The minimum radius for the elbow is 18 inches (450 mm), unless otherwise approved by the Engineer.

NOTE: Do not use multi-cell conduit.

Install conduit and fittings as follows:

1. Ensure that exposed conduit on poles are galvanized rigid steel (GRS) conduit.
2. Ream the ends of metallic conduit after cutting the threads. Ream other conduit as necessary.
3. Cut the ends square, and butt them solidly in the joints to form a smooth raceway for cables.
4. Make conduit joints to form a watertight seal.
5. Coat metallic conduit threads with red- or white-lead pipe compound, thermoplastic or Teflon seal. Ensure that they are securely connected.
6. Make plastic conduit joints with materials recommended by the conduit manufacturer.
7. Install bushings in the conduit to protect the conductors. When conduit is installed for future use, properly thread and cap the ends of the metallic conduit runs.
 - a. Plug the ends of nonmetallic conduit runs to prevent water or other foreign matter from entering the conduit system.
 - b. Seal the exposed conduit ends with a permanently malleable material.
 - c. Ensure that empty conduit installed for future wire or cable has a nylon pull string or cord inside that is impervious to moisture and rot and can withstand a load of 50 pounds (23 kg) without breaking. Secure this pull cord at each open end and at each pull box.
8. Ensure that conduit on pole exteriors are mounted with galvanized, two-hole straps or clamps. Place the clamps not more than 3 feet (1 m) from junction boxes, condulets, or weatherheads. Place it at 3 foot (0.9 m) intervals elsewhere.
 - a. Fasten the clamps to wood poles with galvanized screws or lag bolts.
 - b. Do not install conduit risers on concrete, steel, or mast arm poles unless approved by the Engineer.
9. Install a weatherhead at the end of exterior conduit runs on a pole or other structure to prevent moisture of other matter from entering the conduit.

10. After installation, ensure that the conduit or fitting placement has not warped or distorted any conduit, terminal, or control or junction box.
11. Ensure Conduit that is terminated at poles is grounded at the pull box.

S. Underground Conduit

Underground conduit includes encased or direct burial conduit.

1. Install the conduit in a trench excavated to the dimensions and lines specified in the Plans.
 - a. Provide at least 18 inches (450 mm) finished cover, unless otherwise specified.
 - b. Under pavement, excavate at least 36 inches (900 mm) below the bottom of the pavement.
2. Before excavation, the Contractor is responsible for determining the location of electrical lines, drainage, or utility facilities in the area to prevent damage.
 - a. Place the conduit where it will not conflict with proposed guardrail, sign posts, etc.
 - b. Change locations of conduit runs, pull boxes, etc., if obstructions are encountered during excavation. Changes are subject to the Engineer's approval.
 - c. Where possible, provide at least 12 inches (300 mm) between the finished lines of the conduit runs and utility facilities such as gas lines, water mains, and other underground facilities not associated with the electrical system.
3. When the conduit run is adjacent to concrete walls, piers, footings, etc. maintain at least 4 inches (100 mm) of undisturbed earth or firmly compacted soil between the conduit and adjacent concrete or, when the conduit is encased, between the encasement and the adjacent concrete. Unless specified in the Plans, do not excavate trenches in existing pavement or surfaced shoulders to install conduit.
4. When placing conduit under an existing pavement, install the conduit by jacking and boring, or other approved means. See [Section 615](#) for jacking and boring pipe specifications. Obtain the Engineer's approval prior to installing conduit by means of boring-method.
5. When the Plans allow trench excavation through an existing pavement or surfaced shoulder, restore the pavement shoulder surface, base, and subgrade according to the Specification.
6. Cut trenches for conduit on a slight grade (0.25 percent minimum) for drainage, unless otherwise specified. When the grade can not be maintained all one way, grade the duct lines from the center, both directions, down to the ends.
7. Avoid moisture pockets or traps. Excavate vertical trench walls.
8. Tamp the bottom of the trench to produce a firm foundation for the conduit.
9. When necessary to prevent damage, sheet and brace the trenches and support pipe and other structures exposed in the trenches.
10. Conduit installed for fiber optic cable installation shall have identification tape and detectable tone wire installed for detection as specified and detailed in the Project Standard Detail Sheets.
11. Install direct burial conduit as shown in the Plans. Use rigid galvanized steel, , or polyethylene conduit. Excavate at least 36 inches (900 mm) below the top of the finished ground or 36 inches (900 mm) below the bottom of the pavement.
12. When rock is in the bottom of the trench, install the conduit on a bed of compacted, fine-grain soil at least 4 inches (100 mm) thick.
13. Conduit installed for fiber optic cable installation shall have detectable tone wire installed for detection as specified in [Section 682](#) and detailed in Standard Detail Sheets.

T. Encased Conduit

Place encased conduit in the locations shown in the Plans unless otherwise specified. Construct as follows:

1. Construct the encasement using Class A concrete that meets requirements in [Section 500](#) .
2. Extend the encasement or conduit under roadway pavements or surfaces 6 inches (150 mm) past the outer edge of paved shoulders or sidewalks, or past curbs if no shoulder or sidewalk is present.
3. Extend the conduit at least 3 inches (75 mm) beyond the encasement.
4. Place 3 inches (75 mm) of concrete in the bottom of the trench and place the conduit on top of it.
5. Temporarily plug the ends of the conduit to prevent concrete or foreign materials from entering.

6. Cover the conduit with at least 3 inches (75 mm) of concrete. Wait to encase the conduit with concrete until the Engineer inspects and approves the conduit.
7. Cure the concrete encasement according to [Subsection 500.3.05.Z](#), except curing may be reduced to twenty-four (24) hours. Use a precast encasement if approved by the Engineer.

U. Backfilling

Immediately backfill the conduit after the Engineer’s inspection and approval, except for encased conduit, which must complete a twenty-four (24) hour cure period.

1. Backfill with approved material free of rocks or other foreign matter.
2. Backfill in layers no greater than 6 inches (150 mm) loose depth, up to the original ground level.
3. Compact each layer to one hundred percent (100%) of the maximum laboratory dry density as determined by [GDT 7](#), [GDT 24a](#), [GDT 24b](#), or [GDT 67](#) whichever applies..

V. Conduit on Structures

Install conduits, condulets, hangers, expansion fittings, and accessories on structures according to the Plans and, unless otherwise specified, the following:

1. Run the conduit parallel to beams, trusses, supports, pier caps, etc.
2. Install horizontal runs on a slight grade without forming low spots so they may drain properly.
3. Run conduits with smooth, easy bends. Hold the conduit ends in boxes with locknuts and bushings to protect the conductors.
4. When not specified in the Plans or Special Provisions, submit the type and method for attachment to structures to the Engineer for submission to the District Traffic Operations Engineer for approval.
5. Ground galvanized rigid steel conduit in pull boxes.

All exposed conduit shall be galvanized, rigid conduit unless otherwise specified.

W. Testing Conduit

After installing the conduit, test it in the presence of the Engineer.

1. Test conduit using a mandrel 2 inches (50 mm) long and 0.25 inches (6 mm) smaller in diameter than the conduit.
2. Repair conduit to the Engineer’s satisfaction if the mandrel can not pass through. If repairs are ineffective, remove and replace the conduit at no additional cost to the Department.
3. Thoroughly clean the conduits. When installing conduit but wiring at a later date:
 - a. Perform the mandrel test.
 - b. Ream the duct opening to remove burrs or foreign matter.
 - c. Thoroughly clean the duct.
 - d. Provide and install a weatherproof cap at each open end.
 - e. All installed conduit not used or containing cable shall have a continuous nylon pull string installed between junction boxes.

X. Grounding

Ground the cabinets, controller, poles, pull boxes, and conduit to reduce extraneous voltage to protect personnel or equipment. See [Section 639](#) and [Section 924](#) for grounding requirements.

NOTE: Grounding shall meet the minimum requirements of the NEC.

Provide permanent and continuous grounding circuits with a current-carrying capacity high enough and an impedance low enough to limit the potential above the ground to a safe level.

Perform grounding as follows:

1. Bond the grounding circuits to nonferrous metal driven electrodes. Use electrodes that are at least 0.625 inches (15 mm) in diameter, 8 feet (2.4 m) long, and are driven straight into the ground.
2. Use the shortest possible ground lead that leads directly to a grounding source.
3. Ensure that the maximum resistance between the ground electrode and the earth ground is no greater than twenty five (25) ohms.

4. Connect the ground electrodes and the ground wire with an exothermic weld or ground rod clamp as approved by Signal Engineer.
5. Connect neutral conductors to the cabinet buss-bar and ground them at each terminal point.
6. Ground the cabinet with a No. 6 AWG solid copper wire between the buss-bar to the ground electrode. Bends shall not exceed 4 inch (100 mm) radius bends.
7. Permanently ground the poles by bonding the No. 6 AWG solid copper wire to a separate ground rod.
8. Ground pole-mounted accessories to the pole.
9. Underground metallic conduit or down guys are not acceptable ground electrodes. Do not use Snap-On connections.
10. For extended distances between Ramp Meter and IVDS additional grounding may be required by the manufacturer.

Y. Ground Rod

Install copper clad ground rods adjacent to the traffic signal pole bases, controller cabinet bases, and in pull boxes to shield and protect the grounding system.

When ground rods are not protected, bury them at least 2 inches (50 mm) below the finished ground level. See [Section 924](#) for information pertaining to ground rod composition.

1. Use 0.625 inch (15 mm) diameter ground rods at least 8 feet (2.4 m) long. Use copper clad ground rods.
2. Drive single ground rods vertically until the top of the rod is no more than 2 inches (50 mm) above the finished ground.
3. Attach a length of No. 6 AWG solid copper wire to the top of the ground rod using an exothermic weld.
4. When controller cabinets are mounted on timber poles, ground them with No. 6 AWG solid copper wire attached to the ground rod. Run the wire inside a minimum 0.75 inch (19 mm) rigid conduit attached to the timber pole and to the chassis ground in the controller cabinet.
5. When ground penetration is not obtained:
 - a. Place a horizontal ground rod system of three (3) or more parallel ground rods at least 6 feet (1.8 m) center-to-center and 30 inches (720 mm) below the finished ground.
 - b. Ensure that this grounding system produces a resistance of 25 ohms or less.
 - c. Join the ground rods and connect them to the grounding buss of the traffic signal cabinet with No. 6 AWG solid copper wire.
6. Install a ground wire on wood poles.
 - a. Use at least No. 6 AWG solid copper wire bonded to the grounding electrode and extending upward to a point perpendicular to the uppermost span.
 - b. Place wire staples no greater than 2 feet (0.6 m) apart to secure the ground wire to the pole.
 - c. Connect the span wire to the pole ground using copper split bolt connectors. Provide a separate ground rod for pole mount cabinets. Do not use the pole ground. Bond the pole ground to the pole cabinet ground rod.
7. Ensure that grounding for signal strain poles conforms to the grounding assembly typical erection Detail Sheet in the Plans.
8. Permanently ground cabinet and cabinet conduits to a multi-terminal main ground buss.
 - a. Use a No. 6 AWG solid copper wire bonded between the buss and grounding electrode.
 - b. Connect the power company neutral, conduit ground, and grounds of equipment housed in the cabinet to the buss-bar.
 - c. Do not ground to a permanent water system instead of the driven ground rod. Ensure that grounding devices conform to the requirements of the NEC and NEMA.
9. When testing for resistance ensure the ground is dry. The Contractor is responsible for submitting the ground test results.

Z. Signal Poles

See [Section 501](#) for signal pole materials certification and [Subsection 925.2.27](#), [Subsection 925.2.28](#), [Subsection 925.2.29](#), [Subsection 925.2.30](#) and [Subsection 925.2.31](#) for traffic signal equipment. Refer to the Plans for pole locations.

Where necessary, adjust pole location to avoid utility conflicts. Provide minimum clearance distances between the signal pole and the roadway as specified in the Plans and on the Standard Detail Drawings.

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1. Strain Poles

Provide signal strain poles that conform to [Section 639](#).

Provide caissons or foundations that conform to the “Construction Detail for Strain Pole and Mast Arm Pole Foundations” in the Plans.

Determine the required foundation size based on the manufacturer’s specified “bending moment at yield” for each pole.

Provide strain poles with manufacturer-installed holes for pedestrian heads and push buttons. Seal unused holes with water tight plugs that match the pole finish provided by the manufacturer of the pole. All holes that are used shall have a rubber grommet or weather head.

Rake the poles during installation to provide a pole that is plumb once the load is applied.

2. Metal Poles

Install metal poles as follows:

- a. Ensure that anchor bolts, reinforcing bars, and ground rods conform to [Section 639](#) and [Section 852](#) and are placed in the excavation.
- b. Support the anchor bolts with a template to provide the proper bolt circle for the pedestal or pole to be installed.
- c. Wire the reinforcing bars together or to the anchor bolts.
- d. Wire the conduits in the base to the reinforcing bars for support. Ensure that they are accessible above and beyond the foundation.
- e. Before pouring the foundation concrete, determine that the anchor bolt orientation is correct so that the tensile load is divided between at least two anchor bolts. Pour and vibrate the concrete with the Engineer present.
- f. Ensure that the pole foundations and pedestals with the anchor-type base conform to [Section 500](#) and [Section 639](#). Do not install or locate poles without the Engineer’s approval. Ensure the foundation meets AASHTO guidelines.
 1. The Engineer may take a concrete test cylinder as it is being poured.
 2. Cure the cylinder and submit it for testing to the Office of Materials and Research.
- g. If the concrete foundation fails to meet the requirements of the Specifications and is not accepted, replace the foundation upon notification of failure.
- h. After installing poles and applying the load of the signal span, inspect them for plumb and for the proper horizontal position of the mast arm, when applicable. Make sure all threads of the nut are threaded onto the anchor bolt.
- i. Correct deficiencies by using the leveling nuts on the anchor bolts or by adjusting the mast arm.
- j. The Engineer will examine the pedestals and poles for damaged paint or galvanizing. Restore the finish coating where necessary.
- k. After the Engineer approves the pole installation, provide an acceptable method of protecting the area between the pole base and the top of the foundation to prevent the accumulation of debris.

If the finish or galvanized steel materials is scratched, chipped, or damaged, the material will be rejected. The finish may be replaced as specified under [Section 645](#), with the Engineer’s approval.

NOTE: Never add holes or openings to the metal pole or mast arm without approval from the Office of Bridge and Structural Design.

- l. For poles or arms that need galvanization, thoroughly clean the steel poles and arms and touch up non-galvanized parts with i-d red or original-type primer.
- m. Apply the remaining coats according to the System V (Heavy Exposure) [Section 535](#), unless otherwise indicated in the Plans. The entire pole shall be the same color.
- n. Install a service bracket and insulator on one pole at each intersection to attach power service wire as specified in the Plan Details. Install a disconnect box on the cabinet pole at each intersection to attach power service where the power service is provided overhead.
- o. Install poles to which controller cabinets are attached with mounting plates, bolts, nipples, and at least two, 2.5 inch (64 mm) threaded openings at the top and at least two (2) 2 inch (50 mm) at the bottom of the pole.

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- p. Attach the fittings to the poles as specified by the manufacturer in the Plans or as the Engineer directs. The fittings may include:
- Cast aluminum cap
 - Pole clamp hardware for span wire attachment
 - Weatherhead with chase nipples and couplings
 - Galvanized elbow with bushing installed by cutting the pole and welding in place around the entire circumference
- q. The Office of Materials and Research will inspect the anchor bolts. If approved, the Office of Materials and Research will display the inspector's hammer stamp mark on the top of the bolt.
3. Concrete Strain Poles
- a. Ensure that concrete strain poles meet the requirements of [Section 639](#). Use concrete poles that have threaded couplings to accept weatherheads, pedestrian head mounting hardware, or utility service points shown in the construction Details.
- b. Install concrete strain poles so that the angle of variance between the eye bolt on the pole and the span wire is less than ten degrees (10°).
- c. Verify pole hole orientations for pedestrian heads, pedestrian push button stations, luminaries arms, etc., with the Engineer prior to proceeding with traffic signal installation. For poles at cabinet location provide at least two 2.5 inch (64 mm) threaded openings at the top of pole and at least two 2.0 inch (50 mm) threaded openings at the bottom.
- d. Plug all unused holes. Use Grout or threaded fitting. Match the finish of the pole.
4. Mast Arms
- Install mast arms that can accommodate traffic signal mounting hardware and that adhere to the manufacturer's recommended procedures and [Section 925](#) and [Section 915](#). Do not add holes.
- a. Seal the openings in the mast arms to prevent pests from entering.
- b. Align the mast arm to allow the signal heads to hang plumb at the correct height without using extensions.
- c. All Mast arms are to be galvanized unless indicated otherwise in the Plans.

NOTE: The Contractor shall submit a "Mast Arm Pole Chart" to the Engineer and the Office of Bridge and Structural Design for review and approval as described in [Subsection 647.1.03.F](#) of this Specification.

Verify pole hole orientations for pedestrian heads, pedestrian push button stations, luminaries arms, etc., with the Engineer prior to proceeding with traffic signal installation.

5. Aluminum Pedestrian Pedestals Poles
- Install aluminum pedestal poles, which adhere to Section 850 on breakaway aluminum bases that meet the requirements for breakaway construction. See Section 925 for breakaway base requirements. See the Standard Detail Drawings for Pole and Foundation Details.
- a. Secure at least four anchor bolts in a concrete foundation as shown in the construction Detail.
- b. As an alternate to a concrete foundation install a Pedestal Foundation Anchor Assembly (Subsection 925.2.29). Install the foundation until the top of the base plate is level with the ground. Slide bolt heads through the keyhole and under the base plate against the bolt head keepers with threads up. Bolt the pole base to the foundation. Adhere to the manufacturers instructions for installation.
- 1.) Use a Universal Driving Tool with the correct kelly bar adaptor and bolts supplied with the tool.
 - 2.) Attach driving tool assembly to the foundation base plate using the bolts provided with each foundation. Be sure to align the tool so the holes in the tool line up with the proper bolt circle on the foundation.
 - 3.) Stand the foundation, with the attached drive tool assembly, upright and attach the drive-tool-foundation to the kelly bar.
 - 4.) Raise the kelly bar until the foundation swings free of the ground. Maneuver the kelly bar until the point of the foundation is over the marked installation location.

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- 5.) Lower the kelly bar until the point of the foundation is forced into the ground and the helix is flush with the ground surface.
 - 6.) Ensure the shaft of the foundation is plumb by checking the shaft with a level on tow sides that are at least 90 degrees from each other. Recheck the shaft to be sure it is plumb when the foundation has penetrated 1 foot into the ground.
 - 7.) When the base plate of the foundation is 1(25 mm) to 2 (50 mm) inches above the g round line remove driving tool.
- c. Contain the wiring inside the pole. Do not allow conduit outside the pole except to wire the pedestrian push button.
 - d. Position the pedestal pole plumb and high enough to clear the pedestrian’s head as shown in the Plans. Ensure that the bottom of the signal housing including brackets is not less than 9 feet or greater than 10 feet from the ground line.
 - e. Instruct the supplier to furnish a mill certificate that shows the alloy and physical properties of the steel used in fabricating the anchor bolts. The bolts may be subjected to a tensile and shear strength test.
6. Timber Poles

Timber poles do not require the use of concrete for filling the cavity around the pole base.

Use timber poles that meet the requirements of [Section 861](#). Use Class II for all signal support poles. Use Class IV for aerial loop lead-in or communication cable if approved by the Engineer. Poles shall be inspected and include AWW stamp.

Drill wood poles to receive the eye bolt so that the angle of variance between the eye bolt and span wire at each connection is less than ten degrees (10°). See the Standard Detail Drawings for additional information.

Guy timber poles use single or double guy wires as shown in the Plans and as directed by the Engineer. Guy helper cables with separate guy wires when helper signal span cables are indicated in the Plans.

NOTE: Never attach down guy wires to eye bolts. Attach down guy wires to angle guy attachment only and install insulating rods on all down guy installations as detailed on Standard Detail Sheets .

AA. Pull Boxes

Ensure that pull boxes conform to the Standard Detail Drawings or Plan Detail Sheet. Install pull boxes as required by the Specifications and Plans.

1. Include provisions for drains in pull box excavations as specified.
2. Do not place the aggregate for the drain until the Engineer approves the excavation.
3. Do not set the pull box until the aggregate is in place.
4. Set the pull boxes in place, level, and install conduits as required. Conduit entrance shall be through the open bottom in Types 1, 2, 3, 4S and 5S. Conduit entrance shall be directly through cored holes in the side walls in Types 4 and 5. Conduit entrance shall be through the conduit terminators in Types 6 and 7.

Adjust the location of the pull box if necessary to avoid obstacles.

Where conduit entrance will be through the side wall in Types 4 and 5, or for conduit other than the terminator size provided in Types 6 and 7, use field cored conduit entrance holes in the side wall of the box. All field coring shall be made with a diamond-tipped masonry hole saw and according to the pull box manufacturer’s recommendations.

Use an underground-type conduit adhesive where joining conduit or conduit bodies of dissimilar materials, such as HDPE-to-PVC sweeps into pull boxes or installing into pull box conduit terminators.

- Do not locate pull boxes on the curb side of the signal pole in the intersection radius return
 - Install pull boxes so that the long dimension is parallel to the adjacent roadway
 - Install the pull box at a location that is level with the surrounding ground or pavement. Do not place a pull box in a ditch or depression. Unless otherwise shown in the Plans, when installed either in a sidewalk or in the ground, the top of the pull box shall be level with the sidewalk or ground surface
5. Obtain the Engineer’s approval, and begin backfilling and installing the frame and cover. Ground metal lids or covers.

BB. Span Wire and Span Wire Assemblies

Use span wire to support signal heads, cable, and other hardware only. Use messenger cable to support the aerial cable plant. Install span wire and messenger wire where specified in the Plans and in accordance with the Standard Detail Drawings. See [Section 925](#) for information on span wire and messenger cable.

1. Install signal span wire not to exceed the sag specified by the pole manufacturer, timber poles shall not exceed 2.5%..
2. Use helper cables where specified in the Plans and on the Standard Detail Drawings.
3. See [Subsection 639.3.05.F](#) except, when erecting cable on a timber pole, in which case locate the attachment point a minimum of 18 inches (450 mm) from the top of the pole, to determine the required attachment point.
4. For construction of a box or modified box span, use bullrings. Be consistent throughout the intersection in use of bull rings or strandvises. If bull rings are not used, standvises shall be interlocked.
5. Install 12 inch (300 mm) diameter drip loop wrapped three times at the cable entrance to signal heads. Arrange cable so that it enters the structure from the bottom of the drip loop. Use a 24 inch (600 mm) diameter drip loop where cables enter a weatherhead and use 24 inch (600 mm) sag at corners of a span.
6. Attach cables to span wire using aluminum wrap with at least three turns of wrap spaced at 6 inch (150 mm) increments. Do not use lashing on span wire.
7. Ground all span wire and down guy assemblies as shown on Standard Detail Sheets. Bond all span wire together and bond to ground at every pole.

CC. Traffic Signal Heads

Place traffic signal heads according to the signal design and Plan Detail Drawings. Deviation from the Plans must be according to the MUTCD, current edition and at the Engineer's approval. Ensure all Traffic Signal Heads at an installation have the same appearance for the signal heads and the LED Modules. The Ramp Metering enforcement device shall be mounted on the back of one signal per lane and wired to the red display. The enforcement device shall be able to be viewed from downstream on the ramp.

1. Install traffic signal heads at least 17 feet (5.1 m), but no greater than 19 feet (5.7 m) over the roadway. All vertically attached signal head assemblies shall have a metal support plate installed within the top section (RED) indication of the signal head for additional support and stability. Install Ramp Metering traffic signal heads as shown on the Plans Detail Drawings.
2. Adjust signal heads on the same approach to have the same vertical clearance.
 - a. Measure the clearance from the pavement to the lowest part of the assembly, including brackets and back plates.
 - b. Mount traffic signals on poles with a clearance of at least 12 feet (3.6 m) but no more than 19 feet (5.8m) above the sidewalk or pavement grade of the center of the highway, whichever grade is higher.
 - c. Mount and adjust Ramp Metering traffic signals as per the Plan Detail Drawings.
 - d. Mount and adjust Ramp Meter enforcement device (head) as per the Plan Detail Drawings.
3. Connect the signal cable to the wire in each signal head to provide the correct signal indication when the cables are connected to the controller cabinet back panels. Do not splice cables. Use wire nuts to make the connections to the LED signal modules leadin. Make all connections in the top section.
4. Install optically programmable (OP) signal heads as shown in the Plans and Standard Detail Sheet and as directed by the manufacturer.
5. Mount OP heads securely or tether them to limit movement.
6. Mask the OP lamp for directing visibility under the Engineer's supervision.
7. Tether signal heads that have tunnel visors longer than 12 inches (300 mm), at the discretion of the Engineer.
8. Attach signal heads to mast arms using rigid mounting brackets. See [Section 925](#) for equipment information. Adjust signal heads on mast arms so that all red indications on the same mast arm are at the same elevation.
9. Install lane control heads for reversible lane systems and Ramp Metering heads as shown in the Plans and the Standard Detail Drawings. Center each signal over the lane or lanes under signal control.
10. Leave a vertical clearance for blank-out signs as shown on the Standard Detail Drawings. Use a spirit level to ensure that the bottom edge of each sign is horizontal.

DD. Pedestrian Signal Heads

Install pedestrian signal heads on wood, concrete, steel strain poles, wood or steel auxiliary poles, or metal pedestal poles. Do not mix pole mount methods at the same intersection installation.

Install the pedestrian signal heads as shown on the Standard Detail Drawings and the intersection Plan Sheets and Drawings.

Leave a vertical clearance from the bottom of the head to the ground level of least 10 feet (3 m) unless specified by the Engineer.

1. Pedestal Mounts

Make pedestal mounts with a lower supporting assembly consisting of:

- a. A 4 inch (100 mm) slip-fitter bracket
- b. Hollow aluminum arms with a minimum inside cross-sectional area equal to a 1.5 inch (38 mm) pipe

Use serrated locking devices that firmly hold the signal heads in the required alignment.

- c. For Pedestal Mounts using side hinge “clamshell”. Secure “clamshell” to pedestal using 0.75 inch (19 mm) wide and 0.30 inch (0.75 mm) thick stainless steel bands. See standard detail drawings.

2. Pole Mounts (Side of Pole)

For Metal poles, use side hinge “clamshell” mounting hardware or hardware as described in Wood Pole, Metal Pole alternate, or pedestrian pole.

a. Side Hinge “Clamshell”

See the Standard Detail Drawings.

b. Wood Pole or Metal Pole alternate:

Make pole mounts with the upper and lower assembly consisting of:

- A post arm with a minimum cross-sectional area equal to a 1.5 inch (38 mm) pipe
- A post hub plate that matches the outside pole contour
- Secure the hubs to metal or concrete poles using 0.75 inch (19 mm) wide and 0.030 inch (0.75mm) thick stainless steel bands. Secure the hubs to wood poles using lag bolts

Space the junctions so that each pedestrian signal head can be directed toward approaching traffic as needed.

Use serrated locking devices that hold the pedestrian signal heads in alignment.

EE. Blank-out Signs

Install blank-out signs as shown on Plans or as follows:

1. Securely fasten the signs to a stationary structure or to a messenger strand support system.
2. Center each sign over the lane or lanes under sign control, where applicable.
3. Leave a vertical clearance for blank-out signs as shown in the Plans or in Subsection [647.3.05.EE, “Traffic Signal Heads.”](#) Use a spirit level to ensure that the bottom edge of each sign is horizontal.
4. Use terminal strips to connect each sign electrically to the external control box or cabinet.
5. Install Ramp Meter Advance Warning Flasher Blank-out signs as shown on the Plans Detail Drawings.

FF. Battery Backup System (BBS)

Install Battery Backup System (BBS) if indicated on the Plans. Only install Battery Backup Systems at locations using LED Signal Heads. Install in accordance with the option as indicated on the Plans.

With the Battery Backup submittal provide calculations for determining the size of the inverter and batteries based on the actual power requirements for the intersection installation. Ensure that all auxiliary items are included in the calculations. Ensure the submittal specifies the model number and the firmware revision that is being supplied.

Ensure that the external cabinet supplied meets the Section 925 Specifications and is base mounted next to the 332A cabinet as specified. Do not attach the battery external cabinet to the 332A cabinet unless otherwise specified. The external cabinet option allows for 2 separate configurations. Ensure that the correct configuration is installed in accordance with the Plans. Make all connections to the 332A cabinet through the base of the cabinets.

Provide date of manufacture of all batteries provided.

Ensure the BBS functions as required by the specifications. Ensure the “ON BATTERY” relay provides an input into the controller Alarm 2. Install the two hour run time circuitry from the normally open contacts in the BBS controller to the AC+ and the mercury coil terminal in the traffic signal cabinet.

Provide copy of all documentation (Operation and Maintenance Manual) for items supplied. Include with documentation any communications firmware and cable required interrogate the unit for status, setup or logs.

GG. Wireless Communications

Install, and integrate the spread spectrum wireless radio system with all necessary hardware in accordance with Special Provision: Section 926 – Wireless Communications Equipment: and Section 927 Wireless Communications Installation.. Prior to installing any equipment perform a radio path Site Survey test. Ensure the test evaluates the Signal Strength (dBm), Fade Margin (dB), Signal-to-Noise Ratio, Data Integrity (poll test), and a complete frequency spectrum scan. Ensure the radio path site survey test is performed using the supplied brand of radio equipment to be deployed. During the initial radio path signal strength test it may be determined that a repeater station may be necessary to complete the intended link. Provide the test results to the Engineer for review and approval. Submit copies of the test results and colored copies of the frequency spectrum scan along with an electronic copy of this information. Final locations of antennas and any necessary repeater stations are to be approved by the Engineer.

Install the antenna in such a manner that avoids conflicts with other utilities (separation distances in accordance with the guidelines of the National Electrical Safety Code) and as specified in the antenna manufacturer’s recommendations. Secure the antenna mounting hardware to the pole and route the coaxial cable such that no strain is placed on the coaxial connectors. On wood pole installations run a separate ground from the antenna to the base of the pole. Bond the antenna mounting hardware to the pole ground using # 6 AWG bare copper wire using split bolt or compression type fitting.

Do not exceed the 1inch (25.4 mm) bend radius of the coaxial cable as it transverses from the cabinet to the antenna assembly. Connect the lightning arrestor to the coaxial cable in the equipment cabinet. Properly ground and secure the arrestor in the cabinet. Permanently label all cables entering the cabinet. Ensure that the power supply for the radio system is **NOT** connected to the GFCI receptacle circuitry located in the cabinet. Place a copy of all manufacturer equipment specifications and instruction and maintenance manuals in the equipment cabinet.

At certain locations it may be necessary to integrate the radio system with an existing communications system. Follow the Details shown in Plans.

647.3.06 Quality Acceptance

A. Testing Loop Detector Installation

Test each loop after installing the conductors in the slots cut in the pavement and before sealing.

- Perform a test where the loop wire is spliced to the shielded lead-in wire and where the shielded lead-in wire enters the controller cabinet
- If there are no splice points, such as in direct entry to the controller cabinet, only perform the tests at the controller
- Record the test results on the Loop Installation Data Sheet in [Table 647-10](#), as shown in this section. Make copies of the data sheet as needed
- Include the data sheets in the records, and place a copy in the controller cabinet

Conduct the following five (5) tests to evaluate each loop installation for acceptance before sealing the loop in the pavement:

1. Induced AC Voltage Test

Read 0.05 V AC or less on a digital voltmeter or no deflection on the pointer of an analog meter.

2. Inductance

Inductance (I) is measured in microhenries (mH), and the total inductance is equal to the inductance of loop plus inductance of the loop lead-in.

Acceptable inductance is within 10 percent (10%) of the calculated value for a single loop with the design criteria listed in [Table 647-8](#) and [Table 647-9](#):

6 ft x 6 ft (3 turns) [1.8 m x 1.8 m (3 turns)]	l = 76 mH per 100 feet of loop lead-in cable l = 76 mH per 30 m of loop lead-in cable
6 ft x 30 ft (2 turns) [1.8 m x 9 m (2 turns)]	l = 126 mH per 100 feet of loop lead-in cable l = 126 mH per 30 m of loop lead-in cable
6 ft x 40 ft (2 turns) [1.8 m x 12 m (2 turns)]	l = 165 mH per 100 feet of loop lead-in cable l = 165 mH per 30 m of loop lead-in cable
6 ft x 50 ft (2 turns) [1.8 m x 15 m (2 turns)]	l = 205 mH per 100 feet of loop lead-in cable l = 205 mH per 30 m of loop lead-in cable
6 ft x 70 ft (2 turns) [1.8 m x 21 m (2 turns)]	l = 285 mH per 100 feet of loop lead-in cable l = 285 mH per 30 m of loop lead-in cable

6 ft x 30 ft (2, 4, 2 turns) [1.8 m x 9 m (2, 4, 2, turns)]	l = 269 mH + 23 mH per 100 feet of loop lead-in cable l = 269 mH + 23 mH per 30 m of loop lead-in cable
6 ft x 40 ft (2, 4, 2 turns) [1.8 m x 12 m (2, 4, 2, turns)]	l = 349 mH + 23 mH per 100 feet of loop lead-in cable l = 349 mH + 23 mH per 30 m of loop lead-in cable
6 ft x 50 ft (2, 4, 2 turns) [1.8 m x 15 m (2, 4, 2, turns)]	l = 429 mH + 23 mH per 100 feet of loop lead-in cable l = 429 mH + 23 mH per 30 m of loop lead-in cable
6 ft x 60 ft (2, 4, 2 turns) [1.8 m x 18 m (2, 4, 2, turns)]	l = 509 mH + 23 mH per 100 feet of loop lead-in cable l = 509 mH + 23 mH per 30 m of loop lead-in cable
6 ft x 70 ft (2, 4, 2 turns) [1.8 m x 21 m (2, 4, 2, turns)]	l = 589 mH + 23 mH per 100 feet of loop lead-in cable l = 589 mH + 23 mH per 30 m of loop lead-in cable

3. Leakage Resistance to Ground

The resistance to ground shall be 5 Mohm or more.

4. Loop Resistance

The resistance reading on an ohmmeter is approximately within ten percent (10%) of the calculated value:

- Acceptable Resistance @ (dc @ 68 °F [20 °C]):ohms(μ)
- No. 18 AWG wire: R = 29.4 μ /mile (or) R = 5.5 x 10⁻³ μ /ft. Approximately 5.5 ohms per 1,000 feet of No. 18 AWG wire)[R = 18.3 μ /km (or) R=18.3 x 10⁻³ μ /m]
- No. 14 AWG wire: R = 13.32 μ /mile (or) R = 2.523 x 10⁻³ μ /ft. Approximately 2.52 ohms per 1,000 feet of No. 14 AWG wire)[R = 8.3 μ /km (or) R=8.3 x 10⁻³ μ /m]
- No. 12 AWG wire: R = 5.2 μ /mile (or) R = 9.85 x 10⁻⁴ μ /ft. Approximately 0.98 ohms per 1,000 feet of No. 12 AWG wire [R = 3.24 μ /km (or) R = 3.24 x 10⁻³ μ /m]

5. Loop Q

Q at 50 kHz is greater than 5.

Report to the Engineer an out-of-range reading on any of the above tests. If a test is found unacceptable, remove the loop, install new wire, and repeat the test procedure.

Include in the test results:

- Type and model number of the equipment used (must be ohmmeter having a high resistance scale of R x 10 KW or greater)
- The last calibration date of the equipment and the scale used

Section 647 —Traffic Signal Installation

Check the loop using an impedance tester to determine the natural operating frequency and impedance. Ensure that the completed units detect all motor vehicles. If the loop detection system does not meet the above test requirements, payment will not be made for work on the signal installation until corrections are completed.

Table 647-10 Loop Installation Data Sheet	
Conditions	
Project Number:	
Date:	
Contractor:	
Weather:	
Temperature:	
Pavement Condition - Wet () or Dry ()	
Location	
City or County:	Phase:
Intersection Name or Number:	Function:
Route Number(s) or Name (s):	Lane Location:
Installation or Plan Sheet Number:	No. of Turns:
Size and Type of Loop:	Downstream/Upstream: Down () Up ()
Distance from Stop Bar:	Distance E.O.P./Curb to Lead-in:
Distance Lead-in Cable:	
Material	
Loop Wire Color/Insulation Type/Gauge:	
Loop Lead-In Wire Color/Insulation Type/Gauge:	
Splice Point:	
Conduit Length from Curb/E.O.P. to Splice Point:	
Conduit Length from Splice Point to Cabinet:	
Sealant Type and Part Number:	
Sealant Manufacturer and Lot No.:	
Interconnect Wire Type and Length:	
Loop Tests	
1. Induced Voltage ____ 2. Inductance ____ microhenries	
3. Leakage Resistance to Ground ____ megohms 4. Loop Resistance ____ ohms 5. Loop Q (Quality) ____ Q	
Comments	
Inspector's Name, and Title	

B. Field Tests

In addition to performing tests during installation and before turning on the equipment, perform the following tests on traffic signal circuits in the presence of the Engineer:

- Test each circuit for continuity

Test each circuit for grounds. If a test fails, repair the circuit immediately. New signals shall operate in the flash mode for three (3) days prior to beginning stop-and-go operation unless otherwise directed by the Traffic Engineer.

For Ramp Metering:

The Contractor shall submit to and obtain approval from the Engineer for Ramp Metering testing procedures for each specific Ramp Meter location. The testing procedure shall demonstrate that all components: hardware, cable, and connections furnished and installed by the Contractor operates correctly and that all functions are in conformance with the specifications.

At a minimum, the Contractor shall demonstrate to the Engineer:

- The IVDS and loop detectors at each location are functioning properly with expected accuracy as specified. IVDS burn-in period shall only be in conjunction with the Ramp Meter signal burn-in period of 30 days.
- The Ramp Meter signals function properly at all stages, including non-metering, startup, metering, and shutdown.
- In multi-lane configurations, the Ramp Meter can operate a simultaneous release of vehicles from all lanes and as well as an alternating or staggered release of vehicles from the two (or three) lanes..
- Queue detectors are functioning as specified, including both queue detection and queue override.
- The Ramp Meter functions properly for both local traffic responsive and time of day operations.
- The advance warning sign can be clearly seen and can be activated and deactivated properly.
- The Ramp Meter can communicate properly with the hub/TMC.
- The traffic enforcement heads are operating as per the Plans and can be seen by enforcement personnel.

The Contractor shall coordinate closely with Engineer for conducting Ramp Meter field operational tests. Note: Pretest should be performed prior to calling the Engineer for formal field tests inspection. Pretest shall be defined as conducting all field tests in accordance with the Ramp Metering field testing procedures submitted and approved. Results of pretests shall be recorded and submitted to the Engineer. The Engineer may require the Contractor to address particular items noted in the pretest before beginning the actual field tests.

Operational test shall not begin until the field tests are accepted by the engineer.that will be performed during the Engineer's inspection. Begin operational tests after the Engineer is satisfied that all work has been completed. After the Ramp Meter has been placed in operation, the Contractor, in coordination with the system integrator, shall demonstrate that all equipment furnished and installed by the Contractor operates with all software and firmware as specified.

After successful completion of the test procedure, each Ramp Meter assembly shall go through a burn-in period for 30 consecutive days of normal Ramp Metering operations. During the burn-in period, the Contractor shall ensure that all Contractor-supplied equipment operates without failures of any type. If any equipment component malfunctions or fails to provide the specified functionality during the 30-day burn-in period, the Contractor shall replace or repair the defective equipment within 48 hours of notification by the Engineer.

After the malfunctioning component(s) have been repaired or replaced to the satisfaction of the Engineer, the Contractor shall begin a new 30-day burn-in period. The new 30-day burn-in period shall apply only to equipment components supplied by the Contractor. In the event of a failure or malfunctioning of equipment furnished by others which prevents the 30-day burn-in test from continuing, the Engineer will suspend the burn-in test and resume when the other equipment failures are corrected.

C. Operational Tests and Equipment Activation

After the equipment is installed and the field tests are completed successfully the Contractor shall request an initial equipment inspection. The Engineer shall notify in writing the District Signal Engineer a minimum of 14 working days prior to the inspection. The District Signal Engineer shall provide an in depth inspection and provide a written punch list of items for the Contractor to correct. Within fourteen days of the notification the Contractor shall correct the items noted.

Prior to activating new equipment and before removal of any existing intersection control or equipment, test and ensure any communications equipment is functional.

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In the event that programming of the controller application is not a pay item for the contract the Engineer will notify the District Signal Engineer a minimum of 14 working days prior to activating the equipment.

Prior to activating equipment all Inductance loop, video detection equipment and detection zones shall be functional and operational.

When defects are resolved, the District Signal Engineer will begin the Contractor's operational test period to demonstrate that every part of the system functions as specified. The operational test shall be concurrent for the entire project.

1. The operational test for the traffic signal and Ramp Metering projects shall be at least thirty (30) days of continuous, satisfactory operation.
2. If a component or system fails or shows unsatisfactory performance, the condition must be corrected and the test repeated until thirty (30) days of continuous satisfactory operation is obtained.
3. The District Traffic Engineer will send the Engineer and Construction Office a letter showing the start, termination, suspension, or successful completion of the operational test period.
4. The District Engineer may recommend payment only after the successful completion of the test period.
5. The Contractor shall obtain written acceptance of the signal installation from the District Traffic Operations Engineer before Final Acceptance.

Costs incurred during operational tests, including power consumption, shall be at the Contractor's expense and included in the price bid for Contract Items.

647.3.07 Contractor Warranty and Maintenance

A. Traffic Signal Equipment Maintenance

See section 150.

If a signal that is the responsibility of the contractor is not functioning properly:

1. Non-Emergency

Commence work on this signal within three (3) days of the written notice from the Engineer. Failure to respond shall result in a per calendar day charged against monies due or that may become due until the maintenance work is started. See Section 108.

The Contractor shall be responsible for all materials, equipment and expertise necessary to correct signal malfunction or repair.

The Department or local municipality will not be held responsible or liable for any alleged damage to the signal or as a result of the signal malfunction due to problems that may occur after the Department or local municipality forces make repairs.

2. Emergency

If the Engineer determines that the signal malfunction or failure is an operational hazard, the Contractor is to take corrective action within three (3) hours of the first attempt of notification. Response shall be considered only when qualified personnel and equipment are provided.

Failure to respond within three (3) hours will result in a non-refundable deduction of money of \$1,000.00 with an additional charge of \$500.00 per hour after the first three (3) hours until qualified personnel and equipment arrives on site and begins corrective action.

In addition, the cost of labor and material will be charged by the Department if the Department takes corrective action using its own forces or local municipality forces.

Total charges will not exceed \$5,000.00 (per emergency call) in addition to the material cost and labor incurred to make repairs by the Department or local municipality forces responding to the malfunction.

The Department will not be held responsible or liable for any alleged damage to the signal or as a result of the signal malfunction due to problems that may occur after Department or local municipality forces make emergency repairs.

The Contractor shall be responsible for all materials and equipment necessary to correct signal malfunction or repair.

Final Acceptance will not be given until payment for such work is received.

B. Warranties

Provide manufacturer's warranties or guarantees on electrical, electronic, or mechanical equipment furnished, except state-supplied equipment.

Section 647 —Traffic Signal Installation

Ensure that warranties and/or guarantees are consistent with those provided as customary trade and industry standard practices; or as otherwise specified in the Plans, Standard Specifications, or Special Provisions.

Upon Final Acceptance, transfer the manufacturer and Contractor warranties or guarantees to the Engineer. Ensure that warranties are continuous and state that they are subject to transfer.

Acceptance or approval of the Work does not waive warranties or guarantees where required by the Specifications. Final Acceptance will not be granted until all warranties and guarantees are received.

C. Guaranties

Repair and/or replace all equipment and material supplied under these Contract Documents which has been determined by the Engineer to not meet Specifications.

The Engineer reserves the sole right to determine suitability or unsuitability of the supplied equipment and material. The Contractor shall bear the total cost of delivery and transportation related to the repair and replacement of equipment and material throughout the duration of the Contract unless otherwise approved by the Engineer.

Transfer to the Engineer any warranties and guarantees remaining on all items after Final Acceptance. Perform transfer at 12:01 AM of the day following Final Acceptance.

647.4 Measurement

647.4.01 General

Traffic signal items complete, in place, and accepted of the kind, size, and type specified are measured as follows:

A. Traffic Signal Installation

Signal installation will be paid for by lump sum, including furnishing labor, materials, tools, equipment, and incidentals required to complete the work unless otherwise specified in this Subsection.

B. Communications Wire, Fiber Optic Cable

The number of feet (meters) of communications cable, wire or fiber optic cable, is the actual number of linear feet (meters) of the size installed and accepted. Communications cable shall be paid for under [Section 935](#).

B. Strain Poles, Traffic Signs

Highway signs are measured and paid for under [Section 636](#). Strain poles are measured and paid for under [Section 639](#).

C. Type 4, 4S, 5, 5S, 6 and 7 Pull Boxes

The number of pull boxes will be the actual number of pull boxes installed and accepted.

D. Loop Detector – Maintenance Milling and Resurfacing Projects

The number of loop detectors will be the actual number of loop detectors installed as specified in the Plans or as directed by the Engineer and accepted. Loop detector lead-in cable will not be measured separately for payment but will be included in the price submitted for Loop Detectors.

647.4.02 Limits

General Provisions 101 through 150.

647.5 Payment

647.5.01 General

The lump price bid for Traffic Signal and/or Ramp Meter Installation covers all Items of work in this Specification including furnishing labor, materials, tools, equipment, and incidentals required to complete the work.

Costs for installation, operation, maintenance, and removal of the traffic signal equipment are included under this Item.

Include payment for removal; disposal of existing pavement, shoulder surface, base and sub-grade; and restoration to original condition in the Contract Price for the items to which they pertain. They will not be paid for separately.

Furnishing, installing, and removing sheeting, bracing, and supports will not be paid for separately, but is included in the Contract Prices for other items.

No additional payment will be made for testing and storing State-supplied or Contractor-furnished traffic signal equipment.

No payment will be made for individual items unless a pay item is included in the Plans for the specific item.

Type 4, 4S, 5, 5S, 6, and 7 pull boxes will be paid for per each. Loop Detector will be paid for per each.

Section 647 —Traffic Signal Installation

Payment will be made under:

Item No. 647-Traffic signal installation no-	Per lump sum
Item No. 647- Pull Box PB4	Per each
Item No. 647- Pull Box PB4S	Per each
Item No. 647-Pull Box PB5	Per each
Item No. 647-Pull Box PB5S	Per each
Item No. 647-Pull Box PB6	Per each
Item No. 647-Pull Box PB7	Per each
Loop Detector	Per each

Payment for various elements of traffic signals will be as shown on the Plans.

A. Partial Payment

The Contractor may initiate a partial payment process for the lump sum traffic signal Items by submitting a written request to the Engineer. If the Engineer approves this request, payment will be made as follows:

Underground (loops, pull boxes, and conduits)	20%
Overhead (span, heads, poles, push buttons)	30%
Cabinet, contents, and base	20%
Successful completion of operational test	10%

B. Additional Items

Payment Items related to Section 647 are described in the following sections:

Strain Poles	Section 639
Highway Lighting	Section 680
Lighting Standards and Luminaries	Section 681
Electrical Wire, Cable, and Conduit*	Section 682
Grassing	Section 700
Timber Poles	Section 639 and Subsection 861.2.02
Sign Blanks	Section 912
Reflectorization Materials	Section 913
Traffic Signal Equipment/Ramp Metering Equip.	Section 925
* Payment for conduit installation shall be as described in Section 682 unless conduit installation is performed as part of a traffic signal installation, in which case measurement and payment is a part of the complete traffic signal installation. Payment is Lump Sum, unless listed as a separate pay item.	

647.5.02 Adjustments

General Provisions 101 through 150.

First use date: December 16, 2005

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May 8, 2007

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September 17, 2007

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA

SPECIAL PROVISION**

Section 648-Traffic Impact Attenuator

Delete Section 648 and substitute the following:

648.1 General Description

This work includes furnishing and installing impact attenuator units/arrays to conform with Plan locations and details and/or as directed by the Engineer. All impact attenuator units/arrays shall be tested and approved at the specified NCHRP 350 Test Level.

648.1.01 Definitions

General Provisions 101 through 150.

Gating-A gating end treatment allows a vehicle impacting the nose or the side of the unit at an angle near the nose to pass through the device

Non- Gating-A non-gating end treatment is capable of redirecting a vehicle impacting the nose or the side of the unit along the unit's entire length.

648.1.02 Related References

A. Standard Specifications

General Provisions 101 through 150

B. Referenced Documents

National Cooperative Highway Research Program (NCHRP) Report 350.

ASTM A 123/A 123M

QPL 64

Roadside Design Guide

648.1.03 Submittals

A. Installation Drawings

Submit all required certifications, test reports and drawings of details for completing the installation. Obtain Engineer's approval of these documents before beginning work on attenuator installation. Portable Impact Attenuator arrays shall meet the requirements of Ga. Std. 4960 and manufacturer specifications.

B. Manufacturer's Information

Submit certification from the manufacturer that the attenuator unit/array and its interconnecting hardware replicates an NCHRP-350 approved attenuator in an accepted letter from the FHWA. Furnish items such as manufacturer's brochures or specifications that completely outline the manufacturer's recommendations for materials and installation methods. All workmanship and materials are subject to the Engineer's approval.

648.2 Materials

A. Attenuator

1. Ensure that materials are in accordance with the manufacturer’s recommendations, specifications and details.
2. Use attenuators that have been classified as “accepted” by the Department’s Office of Materials and Research and approved by the Federal Highway Administration (FHWA) as meeting NCHRP-350 for the test level specified.
3. Where restoration and/or repair cannot be accomplished without the necessity of removing the unit/array from the original location, ensure replacement unit/array installation upon removal of the damaged unit/array. Furnishing, installing and maintaining the replacement will be at no additional cost.
4. Where required, ensure the approach end of the attenuator is equipped with a reflectorized object marker in accordance with Plan Details. The object marker may be furnished by the manufacturer of the attenuator or by others. Ensure that the front most section of the unit (the "nose") is yellow in color unless specified otherwise.
5. Where required, use an approved back-up system as specified in the Plans.
6. For non-gating attenuators, anchor the attenuator to the pavement according to a system recommended by the manufacturer for the type pavement encountered.
7. Use Class "A" concrete for reinforced concrete pads, concrete back up if used, and concrete transition where required.
8. Use metal components and hardware galvanized according to ASTM A 123/A 123M unless otherwise specified. Ensure all metal components and hardware of permanent attenuators are free of corrosion when shipped.
9. In freezing conditions, water filled attenuators shall be treated according to the manufacturer’s recommendations.

648.2.01 Delivery, Storage, and Handling

A. General

General Provisions 101 through 150.

648.3 Construction Requirements

648.3.01 Personnel

General Provisions 101 through 150.

648.3.02 Equipment

General Provisions 101 through 150.

648.3.03 Preparation

General Provisions 101 through 150.

648.3.04 Fabrication

A. Design Criteria and Type Selection

The Impact Attenuator Unit/array Type will be shown on the plans and designated by four characters.

- First character

Indicates the type of permanent installation.

The letter "P" designates a permanent (non-gating) installation.

The letter "S" designates a permanent self restoring (non-gating) installation which is capable of withstanding multiple hits without requiring repair or adjustment.

- Second character

Designates the required NCHRP test level.

- Third character

Indicates the traffic flow direction(s).

The letter "B" indicates bi-directional traffic typical for median applications or when the unit is installed on the shoulder of a two-lane, two-way traffic facility. Bi-directional means traffic flows in opposite directions at the site of the attenuator installation.

Section 648 – Traffic Impact Attenuator

The letter "U" indicates uni-directional traffic flow typical for gore areas. Uni-directional means traffic on both sides traveling the same direction, from the nose to the rear of the unit.

The letter "S" indicates traffic flow in one direction on a single side only, typical for a unit located on the outside shoulder of a roadway with one-way traffic and the other side of the attenuator not being exposed to traffic.

- **Fourth character**

Indicates the numerical value of the width, in inches (millimeters), of the base of the rigid object that the attenuator will be shielding.

At bridge columns, this character is typically the width of the column plus the barrier base widths on the column sides at the pavement surface.

B. Example

A Type P-3-U-60 attenuator designates

a permanent installation

tested and approved at NCHRP test level 3

Uni-directional traffic flow

a 60" (1500 mm) wide base for the rigid object being shielded.

Temporary portable units/arrays may be either gating or non-gating based on construction sequencing and/or field conditions, See Specification Section 150. Unless otherwise specified, all permanent attenuators shall be non-gating.

648.3.05 Construction

Field locate the position of the attenuator nose as shown on the plans prior to beginning the installation. Have any variations approved by the Engineer.

If the length of the attenuator unit/array is less than that indicated in the plan details for the specified conditions, the length of the concrete transition section or the length of the longitudinal barrier shall be increased as needed to provide a proper beginning point for the attenuator nose as shown in the plans.

The length of the system will be the combined length of the attenuator unit/array, the back-up system and any required transition. The length of the system shall not be excessive to the extent that it intrudes appreciably within the clear offset distance as shown on the plans.

The increased length of transition or barrier is considered as an incidental part of the system and will not be itemized separately.

Temporary portable units/arrays shall be installed, moved, reinstalled and maintained as required.

648.3.06 Quality Assurance

Obtain certification from the manufacturer that the impact attenuator unit/array installed meets all required approvals and specifications and furnish these to the Engineer.

Furnish any mill test/galvanizing test reports and heat numbers for all metal components of the unit per current requirements of the Department's Office of Materials and Research.

648.3.07 Contractor Warranty and Maintenance

General Provisions 101 through 150.

648.4 Measurement

Each traffic impact attenuator of the type specified, complete, in place and accepted at its location will be measured by the unit/array, including components, hardware, anchors, incidentals, freeze treated water or sand, and labor for each installation shown on the plans or as directed by the Engineer.

Site preparation work, as described under 648.3.03, "Preparation" is measured and paid for separately under the respective items involved unless otherwise specified.

Temporary units/arrays will be measured for payment only once, regardless of how often they are moved. See Specification Section 150.

Section 648 – Traffic Impact Attenuator

648.4.01 Limits

General Provisions 101 through 150.

648.5 Payment

Impact Attenuator Units/Arrays will be paid for per each type specified. Payment is full compensation for all materials, labor, and incidentals necessary to complete the Item including installing, moving, reinstalling and maintaining Units/Arrays as required.

Payment will also include the back-up system and transitions where required.

Payment will be made under:

Item No. 648	Impact attenuator unit, Type P-	Per each
Item No. 648	Impact attenuator unit, Type S-	Per each

648.5.01 Adjustments

General Provisions 101 through 150.

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA**

SUPPLEMENTAL SPECIFICATION

Section 652—Painting Traffic Stripe

Delete Section 652 and substitute the following:

652.1 General Description

This work includes furnishing and applying reflectorized traffic line paint according to the Plans and these Specifications.

This Item also includes applying words and symbols according to Plan details, Specifications, and the current Manual on Uniform Traffic Control Devices.

652.1.01 Definitions

Painted Stripes: Solid or broken (skip) lines. The location and color are designated on the Plans.

Skip Traffic Stripes: Painted segments between unpainted gaps as specified on the Plans. The location and color are designated on the Plans.

652.1.02 Related References

A. Standard Specifications

[Section 656—Removal of Pavement Markings](#)

[Section 870—Paint](#)

EPA Method 3052

EPA Method 6010C

B. Referenced Documents

[QPL 46](#)

AASHTO M 247

652.1.03 Submittals

General Provisions 101 through 150.

652.2 Materials

Ensure that materials for painting traffic stripe, words, and symbols meet the following requirements:

Material	Section
Traffic Line Paint 5A and 5B	870.2.02.A.2 and 870.2.02.A.3
Glass Beads for Use in Luminous Traffic Lines	AASHTO M 247 Type 1 or 2*

*In addition, meet the following requirements for glass beads:

- Maximum quantity of angular particles is less than 1% by weight
- Maximum quantity of particles with milkiness, scoring, or scratching is less than 2% by weight
- Glass beads do not impart any noticeable hue to the paint film
- Glass beads do not contain greater than 200ppm total arsenic, 200ppm total antimony, or 200ppm total lead when tested according to US EPA Methods 3052 and 6010C, or other approved methods.

652.2.01 Delivery, Storage, and Handling

General Provisions 101 through 150.

652.3 Construction Requirements

652.3.01 Personnel

General Provisions 101 through 150.

652.3.02 Equipment

A. Traveling Traffic Stripe Painter

Use a traffic stripe painter that can travel at a predetermined speed both uphill and downhill, applying paint uniformly. Ensure that the painter feeds paint under pressure through nozzles spraying directly onto the pavement.

Use a paint machine equipped with the following:

1. Three adjacent spray nozzles capable of simultaneously applying separate stripes, either solid or skip, in any pattern.
2. Nozzles equipped with the following:
 - Cutoff valves for automatically applying broken or skip lines
 - A mechanical bead dispenser that operates simultaneously with the spray nozzle to uniformly distribute beads at the specified rate
 - Line-guides consisting of metallic shrouds or air blasts
3. Tanks with mechanical agitators
4. Small, portable applicators or other special equipment as needed

B. Hand Painting Equipment

Use brushes, templates, and guides when hand painting.

C. Cleaning Equipment

Use brushes, brooms, scrapers, grinders, high-pressure water jets, or air blasters to remove dirt, dust, grease, oil, and other foreign matter from painting surfaces without damaging the underlying pavement.

652.3.03 Preparation

Locate approved paint manufacturers on [QPL 46](#).

Before starting each day's work, thoroughly clean paint machine tanks, connections, and spray nozzles, using the appropriate solvent.

Thoroughly mix traffic stripe paint in the shipping container before putting it into machine tanks.

Before painting, thoroughly clean pavement surfaces of dust, dirt, grease, oil, and all other foreign matter.

652.3.04 Fabrication

General Provisions 101 through 150.

652.3.05 Construction

A. Alignment

Ensure that the traffic stripe is the specified length, width, and placement. On sections where no previously applied markings are present, ensure accurate stripe location by establishing control points at spaced intervals. The Engineer will approve control points.

B. Application

Apply traffic stripe paint by machine. If areas or markings are not adaptable to machine application, use hand equipment.

1. Application Rate
 - All work will be subject to application rate checks for both paint and beads.
 - Apply 5 in (125 mm) wide traffic stripe at the following minimum rates:
 - a. Solid Traffic Stripe Paint: At least 25 gal/mile (58.8 L/km)
 - b. Skip Traffic Stripe Paint: At least 6.3 gal/mile (14.8 L/km)

NOTE: Change minimum rate proportionately for varying stripe widths.

2. Thickness
Maintain a 15 mils (0.38 mm) minimum wet film thickness for all painted areas.
3. Do not apply paint to areas of pavement when:
 - The surface is moist or covered with foreign matter.
 - Air temperature in the shade is below 40 °F (5 °C)
 - Wind causes dust to land on prepared areas or blows paint and beads around during application.
4. Apply a layer of glass beads immediately after laying the paint. Apply beads at a minimum rate of 6 lbs to each gallon (700 grams to each liter) of paint.

C. Protective Measures

Protect newly applied paint as follows:

1. Traffic
Control and protect traffic with warning and directional signs during painting. Set up warning signs before beginning each operation and place signs well ahead of the painting equipment. When necessary, use a pilot car to protect both the traffic and the painting operation.
2. Fresh Paint
Protect the freshly painted stripe using cones or drums. Repair stripe damage or pavement smudges caused by traffic according to [Subsection 652.3.06](#).

D. Appearance and Tolerance of Variance

Continually deviating from stated dimensions is cause for stopping the work and removing the nonconforming stripe. (See [Section 656](#).) Adhere to the following measurements:

1. Width
Do not lay stripe less than the specified width. Do not lay stripe more than 1/2 in (13 mm) over the specified width.
2. Length
Ensure that the 10 ft (3 m) painted skip stripe and the 30 ft (10 m) gap between painted segments vary no more than ± 1 ft (300 mm) each.
3. Alignment
 - a. Ensure that the stripe does not deviate from the intended alignment by more than 1 in (25 mm) on tangents or curves of 1 degree or less.
 - b. Ensure that the stripe does not deviate by more than 2 in (50 mm) on curves exceeding 1 degree.

652.3.06 Quality Acceptance

Ensure that stripes and segments of stripes are clean-cut and uniform. Markings that do not appear uniform or satisfactory, either during the day or night, or do not meet Specifications, will be corrected at the Contractor's expense. Work will be subject to application rate checks for both paint and beads.

The following will be accepted:

- Sections of painted stripe, words, and symbols that have dried so that paint will not be picked up or marred by vehicle tires
- Sections placed according to the Plans and Specifications

The Contractor will be relieved of responsibility for maintenance on accepted sections.

A. Correction of Alignment

When correcting a deviation that exceeds the permissible tolerance in alignment, do the following:

1. Remove the affected portion of stripe, plus an additional 25 ft (8 m) in each direction.
2. Paint a new stripe according to these Specifications.

Remove the stripe according to [Section 656](#).

B. Removal of Excess Paint

Remove misted, dripped, or spattered paint to the Engineer’s satisfaction. Do not damage the underlying pavement during removal.

Refer to the applicable portions of [Section 656](#).

652.3.07 Contractor Warranty and Maintenance

General Provisions 101 through 150.

652.4 Measurement

When traffic stripe is paid for by the square yard (meter), the number of square yards (meters) painted is measured and the space between stripes is included in the overall measurement.

Linear measurements are made on the painted surface by an electronic measuring device attached to a vehicle. On curves, chord measurements, not exceeding 100 linear feet (30 linear meters), are used.

Traffic stripe and markings, complete in place, are measured and accepted for payment as follows:

A. Solid Traffic Stripe

Solid traffic stripe is measured by the linear foot (meter), linear mile (kilometer), or square yard (meter). Breaks or omissions in solid lines or stripes at street or road intersections are not measured.

B. Skip Traffic Stripe

Skip traffic stripe is measured by the gross linear foot (meter) or gross linear mile (kilometer). Unpainted spaces between the stripes are included in the overall measurements if the Plan ratio of 1 to 3 remains uninterrupted. Measurement begins and ends on a stripe.

C. Pavement Markings

Markings are words and symbols completed according to Plan dimensions. Markings are measured by the unit.

652.4.01 Limits

General Provisions 101 through 150.

652.5 Payment

Payment will be full compensation for the work under this Section, including the following:

- Cleaning and preparing surfaces
- Furnishing materials, including paints, beads, and thinners
- Applying, curing, and protecting paints
- Protecting traffic, including providing and placing necessary warning signs
- Furnishing tools, machines, and other equipment necessary to complete the Item

Payment will be made under:

Item No. 652	Solid traffic stripe, _____ in (mm), (<u>color</u>)	Per linear mile (kilometer)
Item No. 652	Skip traffic stripe, _____ in (mm), (<u>color</u>)	Per gross linear mile (kilometer)
Item No. 652	Solid traffic stripe, _____ in (mm), (<u>color</u>)	Per linear mile (kilometer)
Item No. 652	Skip traffic stripe, _____ in (mm), (<u>color</u>)	Per gross linear foot (meter)
Item No. 652	Pavement markings, words, and symbols, (<u>color</u>)	Per each
Item No. 652	Traffic stripe, _____ in (mm), (<u>color</u>)	Per square yard (meter)

652.5.01 Adjustments

General Provisions 101 through 150.

Office of Materials and Research

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA**

Special Provision

Section 653—Thermoplastic Traffic Stripe

Delete Section 653 and substitute the following:

653.1 General Description

This work includes furnishing and applying thermoplastic reflectorized pavement marking compound. Ensure that markings conform to Plan details and locations, these Specifications, and the Manual on Uniform Traffic Control Devices.

Thermoplastic traffic stripe consists of solid or broken (skip) lines, words, and symbols according to Plan color, type, and location.

653.1.01 Definitions

Thermoplastic Marking Compound: A heated compound extruded or mechanically sprayed on the pavement that cools to pavement temperature. When combined with glass spheres it produces a reflectorized pavement marking.

Short Lines: Crosswalks, stop bars, arrows, symbols, and crosshatching. Extrude short lines rather than spraying them on. Unless otherwise specified, spray all other lines.

653.1.02 Related References

A. Standard Specifications

[Section 652—Painting Traffic Stripe](#)

B. Referenced Documents

[QPL 46](#)

[QPL 71](#)

Federal Test Standard Number 595B

AASHTO M 249

ASTM D 92

ASTM D 476

ASTM D 762

ASTM D 2240

ASTM D 4960

ASTM E 1710

40 CFR 261.24

EPA Method 3050

EPA Method 6010

EPA Method 7000

Federal Test Standard Number 595B

Section 653—Thermoplastic Traffic Stripe

653.1.03 Submittals

Ensure that the producers of the thermoplastic compound and glass spheres furnish to the Department copies of certified test reports showing results of all tests specified in this Section. Also ensure that producers certify that the materials meet the other requirements of this Section by submitting copies of certification at the time of sampling.

653.2 Materials

A. Requirements

Ensure the resin of the thermoplastic material is an alkyd binder. Use alkyd binder consisting of a mixture of synthetic resins and a high boiling point plasticizer. Use at least one synthetic resin that is a solid at room temperature. Ensure at least 50% of the binder composition is 100% maleic-modified glycerol ester resin. Ensure at least 15% by weight of the entire material formulation consists of binder. Do not use alkyd binder that contains petroleum based hydrocarbon resins. Ensure the finished thermoplastic material is not adversely affected by contact with pavement materials or by petroleum droppings from traffic. Use thermoplastic material that has been evaluated (2 year field evaluation) by the National Transportation Product Evaluation Panel (NTPEP) test facility or other approved test facility. Use thermoplastic material produced from an approved source listed on [QPL 46](#). Use thermoplastic material that meets the requirements of AASHTO M 249 with the following exceptions:

1. Color

Confirm the color of thermoplastic as follows:

- a. White – Use titanium dioxide that meets the requirements of ASTM D 476, Type II, Rutile, as the pigment for white thermoplastic material. Do not use anatase titanium dioxide pigment. Use thermoplastic material free from dirt or tint. Ensure white thermoplastic material heated for 240 ± 5 minutes at 425 ± 3 °F (218 ± 3 °C) and cooled to 77 ± 3 °F (25 ± 2 °C) matches Federal Test Standard Number 595B-Color 17925. Use material, when compared to the magnesium oxide standard using a standard color spectrophotometer according to ASTM D 4960, meets the following:

Scale	Definition	Magnesium Oxide Standard	Sample
Rd	Reflectance	100	75 min.
a	Redness-Greenness	0	-5 to + 5
b	Yellowness-Blueness	0	-10 to + 10

- b. Yellow – Use only non-hazardous pigments as defined by the Resource Conservation and Recovery Act (RCRA) Subarticle C rules, table 1 of 40 CFR 261.24 “Toxicity Characteristic”. Do not use yellow thermoplastic containing more than 3.0 ppm lead by weight when tested in accordance with the most up to date EPA Methods 3050 and 6010 or 7000. Ensure yellow thermoplastic material heated for 240 ± 5 minutes at 425 ± 3 °F (218 ± 2 °C) and cooled to 77 ± 3 °F (25 ± 2 °C) matches Federal Test Standard Number 595B-Color 13538. Use material, when compared to PR#1 Chart using a standard color spectrophotometer according to ASTM D 4960, plots within the following chromaticity coordinates:

	1	2	3	4
X	0.455	0.510	0.472	0.530
Y	0.444	0.485	0.400	0.456

Initial Reflectance (CIE Y): 45 minimum

Ensure the in-service daytime chromaticity for yellow material plots within the following coordinates after a period of 30 days:

	1	2	3	4
X	0.435	0.510	0.449	0.530
Y	0.429	0.485	0.377	0.456

2. Indentation Resistance

Section 653—Thermoplastic Traffic Stripe

Measure the hardness by a Shore Durometer, Type A2, as described in ASTM D 2240. Maintain the temperature of the Durometer, 4.4 lb. (2 kg) load and the specimen for 2 hours at 115 °F (45 °C). Apply the Durometer and 4.4 lb. (2 kg) load to the specimen. The reading must fall between 50 to 75 units, after 15 seconds.

3. Reheating

Ensure that the compound does not break down, deteriorate, scorch, or discolor if held at application temperature of 425 °F (218 °C) for 6 hours and if reheated up to 4 times to the application temperature. Ensure that the color of white and yellow thermoplastic comply with [Subsection 653.2.A.1.a](#) and [Subsection 653.2.A.1.b](#) after prolonged heating or reheating.

4. Drop-On Glass Spheres

Use spheres that meet the requirements of [Subsection 652.2](#). Also, use spheres produced from an approved source listed on [QPL-71](#).

5. Sealing Primer

Place the particular type of two-part epoxy binder-sealer at the application rate as recommended in writing by the thermoplastic material manufacturer.

6. Flashpoint

Ensure the thermoplastic flashpoint is not less than 500 °F (260 °C) as determined by ASTM D 92.

7. Specific Gravity

Ensure the specific gravity of the thermoplastic is between 2.00 to 2.20 as determined by ASTM D 762.

B. Performance Requirements

1. General

For a minimum of 30 days from the time of placement, ensure the thermoplastic pavement marking material shows no signs of failure due to blistering, excessive cracking, chipping, bleeding, staining, discoloration, oil content of the pavement materials, smearing or spreading under heat, deterioration due to contact with grease deposits, oil, diesel fuel, or gasoline drippings, spilling, poor adhesion to the pavement material, vehicular damage, and normal wear. In the event that failures mentioned above occur, ensure corrective work is completed at no additional cost to the Department.

2. Retroreflectivity

At the time of installation, ensure the in-place markings when tested according to ASTM E 1710 meet the following minimum reflectance values:

White	375 mcd/lux/m ²
Yellow	250 mcd/lux/m ²

Retest the in-place markings 30 days after installation to ensure these minimum retroreflectance values are maintained.

NOTE: The Contractor is responsible for retroreflectivity testing. Furnish all test reports to the Department.

In the event failures occur, ensure corrective work is completed at no additional cost to the Department. Perform testing according to ASTM E 1710 at above described intervals. Any retest due to failures will be performed at no additional cost to the Department. Furnish all test reports to the Department.

653.2.01 Delivery, Storage, and Handling

Use material delivered in 50 lb (22.7 kg) unit cardboard containers or bags strong enough for normal handling during shipment and on-the-job transportation without loss of material.

Ensure that each unit container is clearly marked to indicate the following:

- Color of the material
- Process batch number or similar manufacturer's identification
- Manufacturer's name
- Address of the plant

Section 653—Thermoplastic Traffic Stripe

- Date of manufacture

653.3 Construction Requirements

653.3.01 Personnel

General Provisions 101 through 150.

653.3.02 Equipment

Depending on the marking required, use hand equipment or truck-mounted application units on roadway installations.

A. Spray Application Machine

Ensure that each spray application machine is equipped with the following features:

- Parts continuously mix and agitate the material.
- Truck-mounted units for lane, edge, and center lines can operate at a minimum of 5 mph (8 kph) while installing striping.
- Conveying parts between the main material reservoir and the shaping die or gun prevent accumulation and clogging.
- Parts that contact the material are easily accessible and exposable for cleaning and maintenance.
- Mixing and conveying parts, including the shaping die or gun, maintain the material at the plastic temperature with heat transfer oil or electrical element controlled heat. Do not use an external source of direct heat.
- Parts provide continuously uniform stripe dimensions.
- Applicator cleanly and squarely cuts off stripe ends and applies skip lines. Do not use pans, aprons, or similar appliances that the die overruns.
- Parts produce varying widths of traffic markings.
- Applicator is mobile and maneuverable enough to follow straight lines and make normal curves in a true arc.

B. Automatic Bead Dispenser

Apply glass spheres to the surface of the completed stripe using a dispenser attached to the striping machine to automatically dispense the beads instantaneously upon the installed line. Synchronize the glass sphere dispenser cutoff with the automatic cutoff of the thermoplastic material.

C. Special Kettles

Use special kettles for melting and heating the thermoplastic material. Kettles equipped with automatic thermostatic control devices provide positive temperature control and prevent overheating. Ensure that the applicator and kettles are equipped and arranged according to the requirements of the National Fire Underwriters.

D. Hand Equipment

Use hand equipment for projects with small quantities of lane lines, edge lines, and center lines, or for conditions that require the equipment. Use hand equipment approved by the Engineer.

Ensure that hand equipment can hold 150 lbs (68 kg) of molten material and is maneuverable to install crosswalks, arrows, legends, lane, edge, and center lines.

E. Auxiliary Vehicles

Supply the necessary auxiliary vehicles for the operation.

653.3.03 Preparation

General Provisions 101 through 150.

653.3.04 Fabrication

General Provisions 101 through 150.

Section 653—Thermoplastic Traffic Stripe

653.3.05 Construction

A. General Application

Thoroughly clean pavement areas to be striped. Use hand brooms, rotary brooms, air blasts, scrapers, or other approved methods that leave the pavement surface clean and undamaged. Take care to remove all vegetation and road film from the striping area. All new Portland Cement Concrete pavement surfaces shall be mechanically wire brushed or abrasive cleaned to remove all laitance and curing compound before being striped.

Lay stripe with continuous uniform dimensions.

Apply the type of stripe at each location according to the Plans, using one of the following methods:

- Spray techniques
- Extrusion methods wherein one side of the shaping die is the pavement, and the other three sides are contained by or are part of the suitable equipment to heat and control the flow of material.

1. Temperature

Apply thermoplastic traffic stripe only when the pavement temperature in the shade is above 40 °F (4 °C).

To ensure optimum adhesion, install the thermoplastic material in a melted state at the manufacturer's recommended temperature but not at less than 375 °F (190 °C).

2. Moisture

Do not apply when the surface is moist. When directed by the Engineer, perform a moisture test on the Portland cement concrete pavement surface. Perform the test as follows:

- a. Place approximately 1 yd² (1m²) of roofing felt on the pavement surface.
- b. Pour approximately 1/2 gallon (2 L) of molten thermoplastic onto the roofing felt.
- c. After 2 minutes, lift the roofing felt and inspect to see if moisture is present on the pavement surface or underside of the roofing felt.
- d. If moisture is present, do not proceed with the striping operation until the surface has dried sufficiently to be moisture free.

3. Binder-Sealer

To ensure optimum adhesion, apply a binder-sealer material before installing the thermoplastic in each of the following cases:

- Extruded thermoplastic
- Where directed by the Engineer for sprayed thermoplastic
- Old asphaltic concrete pavements with exposed aggregates
- Portland cement concrete pavements as directed by the Engineer

Ensure that the binder-sealer material forms a continuous film that mechanically adheres to the pavement and dries rapidly. Use a binder-sealer currently in use and recommended by the thermoplastic material manufacturer according to [QPL 46](#).

To ensure optimum adhesion, apply a two-part epoxy binder-sealer on all Portland cement concrete pavements for either sprayed or extruded thermoplastic material.

Apply the epoxy binder-sealer immediately in advance of, but concurrent with, the application of the thermoplastic material. Apply in a continuous film over the pavement surface.

4. Bonding to Old Stripe

The old stripe may be renewed by overlaying with new material. Ensure the new material bonds to the old line without splitting or cracking.

5. Offset from Construction Joints

Off-set longitudinal lines at least 2 in (50 mm) from construction joints of Portland cement concrete pavements.

6. Crosswalks, Stop Bars, and Symbols

Make crosswalks, stop bars, and symbols at least 3/32 in (2.4 mm) thick at the edges and no more than 3/16 in (4.8 mm) thick at the center.

7. Film Thickness

- a. Maintain the following minimum average film thicknesses on all open graded asphalt concrete friction courses:

Section 653—Thermoplastic Traffic Stripe

- 0.120 in (3.0 mm)* for lane lines
 - 0.090 in (2.3 mm)* for edge lines
 - 0.150 in (3.8 mm)* for gore area lines
- b. Maintain the following minimum average film thicknesses on all other pavement types:
- 0.090 in (2.3 mm)* for lane lines
 - 0.060 in (1.5 mm)* for edge lines
 - 0.120 in (3.0 mm)* for gore area lines

(See below for ‘*’ reference.)

Compute the minimums by the amount of material used each day, as follows:

(For 5 in wide stripe)	
* Average Film Thickness (in) =	$[(\text{lbs used}) \div (\text{total linear feet})] \times 0.236$
(For 125 mm wide stripe)	
*Average Film Thickness (mm) =	$[(\text{kg used}) \div (\text{total linear meters})] \times 4.0$
(For 10 in wide stripe)	
* Average Film Thickness (in) =	$[(\text{lbs used}) \div (\text{total linear feet})] \times 0.118$
(For 250 mm wide stripe)	
* Average Film Thickness (mm) =	$[(\text{kg used}) \div (\text{total linear meters})] \times 2.0$

8. Glass Spheres
- a. Apply glass spheres to installed stripe surface at a minimum rate of 14 lbs of spheres to each 100 square feet ((700 g/m²) of thermoplastic material.
 - b. Apply the glass sphere top-coating with a pressure-type gun specifically designed for applying glass spheres that will embed at least one-half of the sphere’s diameter into the thermoplastic immediately after the material has been applied to the pavement.

B. Removing Existing Stripe

Remove existing stripe according to [Section 656](#).

Remove 100 percent of existing traffic stripe from:

- Portland cement concrete pavement where the new stripe will be placed at the same location as the existing marking
- Pavement where the new stripe will be placed at a different location from the existing markings

C. Tolerance and Appearance

No traffic stripe shall be less than the specified width and shall not exceed the specified width by more than 1/2 in (13mm). The length of the 10 ft (3 m) segment for skip stripe and the 30 ft (9 m) gap between segments may vary plus or minus 1 ft (300 mm). The alignment of the stripe shall not deviate from the intended alignment by more than 1 in (25 mm) on tangents and on curves up to and including 1 degree (radius of 1745 m or greater). On curves exceeding 1 degree (radius less than 1745 m), the alignment of the stripe shall not deviate from the intended alignment by more than 2 in (50 mm).

Stop work when deviation exceeds the above dimensions, and remove the nonconforming stripe.

653.3.06 Quality Acceptance

Segments of the thermoplastic traffic stripe placed according to the Plans and Specifications may be accepted 30 days after the required work is complete in that segment.

If thermoplastic traffic stripe fails to meet Plan details or Specifications or deviates from stated dimensions, correct it at no additional cost to the Department. If removal of pavement markings is necessary, perform it according to Section 656 and place it according to this Specification. No additional payment will be made for removal and replacement of unsatisfactory striping.

Section 653—Thermoplastic Traffic Stripe

653.4 Measurement

When stripe will be paid for by the square yard (meter), the actual number of square yards (meters) painted will be measured. The space between the stripes will be included in the overall measurement.

Linear measurements may be made by electronic measuring devices attached to a vehicle.

Thermoplastic traffic stripe, complete in place and accepted, is measured as follows:

A. Solid Traffic Stripe

Stripe is measured by the linear foot (meter), linear mile (kilometer), or square yard (meter). Breaks or omissions in solid lines or stripes at street or road intersections are not measured for payment.

B. Skip Traffic Stripe

Skip stripe is measured by the gross linear mile (kilometer) as specified. The unpainted space between the painted stripes is included in the overall measurement if the Plan ratio of one to three (10 ft [3 m] segment and 30 ft [9 m] gap or other patterns as designated on the Plans) remains uninterrupted. Measurement begins and ends on a stripe.

C. Words and Symbols

Each word or symbol complete according to Plan dimensions is measured by the Unit.

653.4.01 Limits

General Provisions 101 through 150.

653.5 Payment

Payment is full compensation for the Work under this section, including:

- Cleaning and preparing surfaces
- Furnishing all materials
- Applying, curing, and protecting stripe
- Protecting traffic, including providing necessary warning signs
- Furnishing tools, machines, and other equipment necessary to complete the Item

Measurement and payment for removing pavement markings will be according to [Section 656](#) when shown in the Proposal as a payment Item. Otherwise, removal will not be paid for separately, but will be included in the payment for other Work under this section.

Payment will be made under:

Item No. 653	Thermoplastic solid traffic stripe, __ in (mm), (color)	Per linear foot (meter)
Item No. 653	Thermoplastic solid traffic stripe, __ in (mm), (color)	Per linear mile (kilometer)
Item No. 653	Thermoplastic skip traffic stripe, __ in (mm), (color)	Per gross linear foot (meter)
Item No. 653	Thermoplastic skip traffic stripe, __ in (mm), (color)	Per gross linear mile (kilometer)
Item No. 653	Thermoplastic pavement markings, words, and symbols (color), type _____	Per each
Item No. 653	Thermoplastic traffic stripe	Per square yard (meter)

653.5.01 Adjustments

General Provisions 101 through 150.

DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA
SUPPLEMENTAL SPECIFICATION

Section 657— Preformed Plastic Pavement Markings

Delete Section 657 and substitute the following:

657.1 General Description

This work includes placing plastic pavement markings or legends according to the Plans and Specifications or as otherwise directed.

657.1.01 Definitions

General Provisions 101 through 150.

657.1.02 Related References

A. Standard Specifications

General Provisions 101 through 150.

B. Referenced Documents

ASTM D 638

ASTM D 4061

ASTM D 4505

ASTM D 4592

ASTM E 303

ASTM E 1710

ASTM E 2177

Manual on Uniform Traffic Control Devices for Streets and Highways

Federal Test Standard 141, Method 6192

[QPL 74](#)

657.1.03 Submittals

Transfer to the Department manufacturer warranties or guarantees for heat-applied and wet reflective preformed plastic marking materials. Ensure that warranties or guarantees state that they are subject to transfer.

657.2 Materials

Select one of the following types of preformed marking material according to the Plans and Proposal:

- Type TR – Temporary Removable Plastic Marking

Section 657— Preformed Plastic Pavement Markings

- Type TN – Temporary Non-Removable Plastic Marking
- Type PA – Permanent Plastic Marking
- Type PB – Permanent Patterned Plastic Marking
- Type PB-WR – Permanent Patterned Wet Reflective Plastic Markings

For a list of sources, see [QPL-74](#).

A. General Requirements for Preformed Pavement Markings

1. Shapes and Sizes

Use markings that conform to the shapes and sizes outlined in the Manual on Uniform Traffic Control Devices for Streets and Highways.

2. Pigmentation

Use white or yellow pigmented plastic according to each marking type.

3. Adhesion

Use markings that can be affixed to bituminous or Portland cement concrete pavements by pressure-sensitive precoated adhesive or a liquid contact cement.

Ensure that marking adhesive adheres to the roadway under normal climactic and traffic conditions.

4. Conformability

Use markings that will mold to pavement contours, breaks, faults, and the like, by normal action of traffic at normal pavement temperatures.

5. NTPEP Evaluation

Use markings evaluated by the National Transportation Product Evaluation Program (NTPEP).

6. Glass or Ceramic Beads

Use markings with a layer of glass or ceramic beads bonded to the surface according to the marking type. Type PB and PB-WR contain both ceramic beads and glass beads. Types TR, TN, and PA contain only glass beads.

Use glass beads with less than 2% by weight showing any milkiness, scoring or scratching. Use clear, transparent beads that are free from air inclusions and conform to the following:

	Glass Beads	Ceramic Beads
Refractive Index, (tested by oil immersion)	1.50 minimum	1.70 minimum
Uniform Distribution of Spheres	0.75 minimum	0.75 minimum

7. Reflective Intensity

Determine reflective intensity in accordance with ASTM D4061 or E1710.

Ensure that marking types TR, TN, and PA use white or yellow film with the initial reflective intensity indicated in the table below, when measured at the angles shown.

	White	Yellow
Observation Angle	1.05°	1.05°
Entrance Angle	88.8°	88.8°
Reflective Intensity – Millicandelas per square meter per lux	500	300

8. Composition

Use markings made of high-quality polymeric materials and pigments. Ensure types TR and PA contain the following composition of materials:

Material	Min% By Weight
Resins and Plasticizers	20

Pigments	30
Graded Glass Beads	33

B. Requirements for Temporary Markings (Types TR and TN)

1. Temporary Removable Markings (Type TR)

Use temporary, removable markings that meet the following requirements:

a. Removability

Ensure the marking material can be removed from asphaltic and Portland cement as follows:

- Lifted intact or in large pieces.
- Lifted either manually or with a roll-up device.
- Lifted at temperatures above 40 °F (5 °C) without using heat, solvents, sand blasting, or grinding.

Ensure the pavement shows no objectionable staining or damage after removing the marking.

b. Elongation and Tensile Strength

Provide temporary markings with the following elongation and tensile strength when tested according to ASTM D 638:

Elongation	50% maximum
Tensile Strength	40 lbs/in ² (275 kPa) minimum

Test as follows:

- 1) Cut a 1 in by 6 in (25 mm by 150 mm) specimen.
- 2) Test at a temperature between 70 °F and 80 °F (21 °C and 27 °C).
- 3) Test at a jaw speed of 12 in/min (300 m/min).

c. Adhesion

Ensure that temporary marking material meets the adhesion requirements of ASTM D4592.

d. Glass Bead Retention

Confirm the glass bead retention quality of marking material in both of the following ways:

1) Laboratory Test

- Take a 2 in by 6 in (50 mm by 150 mm) sample.
- Bend the sample over a ½ in (13 mm) diameter mandrel, leaving the 2 in (50 mm) side perpendicular to the mandrel axis.
- Ensure that the area on the mandrel shows no more than 10 percent of the beads entrapped by the binder less than 40 percent.

2) Field test

Ensure the beads cannot be easily removed by scratching the material firmly with the thumbnail.

e. Skid Resistance

Ensure that the material surface provides a 35 BPN minimum skid resistance value when tested according to ASTM E 303.

f. Thickness

Ensure that the removable marking material is at least 20 mils (0.50 mm) thick not including the backing adhesive.

2. Temporary Non-Removable markings (Type TN)

This type of pavement marking may use a conformable metallic foil backing with a precoated pressure-sensitive adhesive. Skid Resistance

- a. Ensure the retroreflective pliant polymer surface provides a skid resistance value of at least 35 BPN. Test according to ASTM E 303.
- b. Elongation and Tensile Strength

No test for elongation and tensile strength is required for type TN marking.

c. Glass Bead Retention

Refer to [Subsection 657.2.B.1.d, “Glass Bead Retention”](#).

d. Thickness

Ensure the nonremovable marking material is at least 20 mils (0.50 mm) not including the adhesive backing.

C. Requirements for Permanent Markings (Types PA, PB and PB-WR)

1. Permanent Plastic Marking (Type PA)

Provide permanent plastic markings with these features:

a. Adhesive and Backing

Use markings supplied with the following:

- A precoated adhesive
- An easily removable backing to protect the adhesive
- An adhesive backing that allows repositioning of the marking on the surface before permanently sticking with greater pressure

In addition, supply rolls of lane lines with a precoated adhesive but without the protective backing material.

b. Pigments

1) White

Use white marking material meeting the initial color requirements of ASTM D4505.

2) Yellow

Use yellow marking material meeting the initial color requirements of ASTM D4505.

3) Appearance

Ensure that each marking meets the following appearance standards:

- Markings are extruded to a uniform thickness.
- Edges are smoothly cut and true.
- Glass spheres are retained on all sides by the plastic base material.
- The wearing surface is free of indentations, displaced spheres, or other irregularities that retain dirt, dust, or other foreign materials.

c. Thickness

Ensure the permanent material is at least 60 mils (1.52 mm) thick, without the pre-coated adhesive.

d. Glass Bead Retention

Confirm that the surface glass beads are strongly bonded and are not easily removed by traffic. Test them as follows:

- 1) Use a Taber Abraser with an H-18 wheel and 125 gram load.
- 2) Inspect the sample at 200 cycles under the microscope to observe the extent and type of bead failure.
- 3) Ensure that no more than 15 percent of the beads have popped-out.
- 4) Verify that the predominant mode of failure is “wear-down” of the beads.

e. Tensile Strength and Elongation

Ensure that the permanent markings have the following elongation and tensile strength when tested according to ASTM D 638:

Elongation	50% maximum
Tensile Strength	150 psi (1035 kPa) minimum

Test as follows:

NOTE: Run this test 3 times and base the result on an average of the 3 tests.

- 1) Cut 3 specimens, 1 in by 6 in (25 mm by 150 mm) each.
 - 2) Place 1 in² (625 mm²) of carborundum extra-coarse emery cloth or its equivalent at each end of the test specimens to prevent the adhesive from sticking to test equipment.
 - 3) Test at a temperature between 70 ° and 80 °F (21° and 27 °C).
 - 4) Test at a jaw speed of 10 to 12 in/min (250 mm to 300 mm/min).
- f. Skid Resistance
Test the plastic surface to verify that it provides a skid resistance value of at least 45 BPN. Test according to ASTM E 303.
- g. Adhesive
Ensure permanent markings meet the adhesion requirements of ASTM D4505.
2. Permanent Patterned Plastic Marking (Type PB)
Use patterned plastic markings with these features:
- a. Patterned Surface
Ensure that the patterned surface has the following characteristics:
 - A reflective layer of ceramic beads bonded to a durable polyurethane topcoat.
 - The raised area comprises approximately 40% ± 15% of the total marking face.
 - The surface presents a near vertical face (β angle of 0° to 60°) to traffic from any direction.
 - The Office of Materials and Research approves the pattern configuration.
 - The channels between raised areas are free of exposed beads or particles.
 - b. Adhesive and Backing
Refer to [Subsection 657.2.C.1.a, “Adhesive and Backing”](#).
 - c. Pigments
Refer to [Subsection 657.2.C.1.b, “Pigments”](#).
 - d. Ceramic Beads
Ensure that the top layer of ceramic beads is bonded to a durable polyurethane surface.
 - e. Ceramic Bead Retention
Refer to [Subsection 657.2.C.1.d, “Glass Bead Retention”](#).
 - f. Thickness
Ensure the permanent material is at least 60 mils (1.52 mm) thick at the thickest portion of the patterned cross-section, and at least 20 mils (0.508 mm) at the thinnest portion of the cross-section.
 - g. Tensile Strength and Elongation
Refer to [Subsection 657.2.C.1.e, “Tensile Strength and Elongation”](#).
 - h. Skid Resistance
Refer to [Subsection 657.2.C.1.f, “Skid Resistance”](#).
 - i. Dry Reflective Intensity
Determine reflective intensity in accordance with ASTM D 4061 or E1710. Initial minimum dry reflective values are as follows:

	White	Yellow
Observation Angle	1.05°	1.05°
Entrance Angle	88.8°	88.8°
Reflective Intensity – Millicandelas per square meter per lux	500	300

3. Permanent Patterned Wet Reflective Plastic Marking (Type PB-WR)
Use patterned plastic markings with these features:
 - a. Patterned Surface

Ensure that the patterned surface has the following characteristics:

- A reflective layer of ceramic beads bonded to a durable polyurethane topcoat.
- The raised area comprises approximately 40% ± 15% of the total marking face.
- The surface presents a near vertical face (β angle of 0° to 60°) to traffic from any direction.
- The Office of Materials and Research approves the pattern configuration.
- The channels between raised areas are free of exposed beads or particles.

b. Adhesive and Backing

Refer to [Subsection 657.2.C.1.a, “Adhesive and Backing”](#).

c. Pigments

Refer to [Subsection 657.2.C.1.b, “Pigments”](#).

d. Ceramic Beads

Ensure that the top layer of ceramic beads is bonded to a durable polyurethane surface.

e. Ceramic Bead Retention

Refer to [Subsection 657.2.C.1.d, “Glass Bead Retention”](#).

f. Thickness

Ensure the permanent material is at least 60 mils (1.52 mm) thick at the thickest portion of the patterned cross-section, and at least 20 mils (0.508 mm) at the thinnest portion of the cross-section.

g. Tensile Strength and Elongation

Refer to [Subsection 657.2.C.1.e, “Tensile Strength and Elongation”](#).

h. Skid Resistance

Refer to [Subsection 657.2.C.1.f, “Skid Resistance”](#).

i. Dry Reflective Intensity

Determine reflective intensity in accordance with ASTM D 4061 or E1710. Initial minimum dry reflective values are as follows:

	White	Yellow
Observation Angle	1.05°	1.05°
Entrance Angle	88.8°	88.8°
Reflective Intensity – Millicandelas per square meter per lux	500	300

j. Wet Reflective Intensity

Determine wet reflective intensity in accordance with ASTM E2177.

Ensure that markings meet the following initial minimum wet retroreflective intensity.

	White	Yellow
Divergence Angle	1.05°	1.05°
Incidence Angle	88.8°	88.8°
Reflective Intensity --Millicandelas per square meter per lux	250	200

657.3 Construction Requirements

General Provisions 101 through 150.

657.3.01 Personnel

Send a factory-trained representative from the material manufacturer to the jobsite at the start of each project.

657.3.02 Equipment

General Provisions 101 through 150.

657.3.03 Preparation

General Provisions 101 through 150.

657.3.04 Fabrication

General Provisions 101 through 150.

657.3.05 Construction

Remove existing pavement markings according to [Subsection 653.3.05.B, “Removing Existing Stripe.”](#)

A. Pre-Conditions for Applying Markings

1. Meet the following conditions before applying markings onto new asphaltic pavements:
 - The ambient temperature is 60 °F (15 °C) and rising .
 - New asphaltic pavement temperature is at least 120 °F (49 °C).
 - The plastic can be applied to new asphaltic pavement immediately before the new surface is rolled for the final time.
 - Conventional steel rollers and water used with them do not impede the plastic’s application.
2. Meet the following conditions before applying markings onto all pavements:
 - The ambient temperature is 60 °F (15 °C) and rising.
 - The pavement temperature is at least 70 °F (21 °C) and rising.
 - The previous night temperature did not fall below 40 °F (4 °C).
 - No significant rainfall occurred 24 hours prior to the plastic’s application.

B. Remove Existing Stripe

Remove at least 90% of existing traffic stripe under either of the following conditions:

- On Portland cement concrete pavement where the new stripe is to be placed at the same location as the existing marking
- On all pavements where the new stripe is to be placed at a location different from the existing marking

C. Applying Markings

Apply markings as follows:

3. Thoroughly clean the pavement. Clean with compressed air, hand brooms, rotary brooms, scrapers, or other approved methods which leave the pavement thoroughly clean and undamaged. Remove all vegetation and road film from the area to be striped. Mechanically wire brush or abrasive blast clean all new Portland cement concrete pavement surfaces to remove all laitance and curing compound from the area to be striped.
4. Apply an adhesive activator according to the manufacturer’s recommendations, when required.
5. Position markings according to the Plans.
6. Press positioned markings firmly onto the pavement.
7. Offset longitudinal lines at least 2 in (50 mm) from construction joints of Portland cement concrete pavements.

D. Tolerances and Appearance

1. Cut off all stripe ends squarely and cleanly.
2. The length of the 10 ft (3 m) segment for skip stripe and the 30 ft (9 m) gap between segments may vary plus or minus 1in (25 mm). Do not allow the alignment of skip stripe to deviate from the intended alignment by more than 0.5 in (13 mm). Do not allow the alignment of edge stripe to deviate from the intended alignment by more than 0.5

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in (13 mm) on tangents and on curves with a radius up to and including one degree. Do not allow the alignment of edge stripe to deviate from the intended alignment by more than 1 in (25 mm) on curves exceeding one degree.

3. Stop work when deviation exceeds the above dimensions, and remove the nonconforming stripe.

657.3.06 Quality Acceptance

Segments of preformed plastic traffic stripe that have been placed according to the Plans and Specifications may be accepted 30 days after the required work is complete in that segment. If Preformed Plastic Traffic Stripe fails to meet Plan details or Specifications or deviates from stated dimensions, correct it at no additional cost to the Department. If removal of pavement markings is necessary, perform it according to [Section 656](#) and replace it according to this Specification. No additional payment will be made for removal and replacement of unsatisfactory striping.

657.3.07 Contractor Warranty and Maintenance

A. Warranties

Transfer all warranties or guarantees normally furnished by the manufacturer to the Department. Include a provision that warranties are subject to transfer. Warrant Type PB Plastic Markings to adhere to the pavement and to provide a minimum coefficient of retroreflection of 0.10 candles per ft-candle per square foot (0.10 candela per lux per square meter) when measured at 1.0 ° observation angle and 86.5 ° entrance angle for a period of at least 6 years for longitudinal markings and at least 2 years for intersection markings and symbols under normal traffic conditions.

B. Maintenance

Use the following according to manufacturer's instructions to ensure effective marking performance:

- Solvents or adhesives
- Appropriate equipment
- Recommendations for application

657.4 Measurement

Preformed plastic pavement markings complete in place and accepted are measured as follows:

A. Solid Traffic Stripe

Solid stripe is measured by the linear foot (meter) or linear mile (kilometer) as specified. Breaks or omissions in solid lines and stripes at street or road intersections are not measured for payment.

B. Skip Traffic Stripe

Skip stripe is measured by the gross linear foot (meter) or gross linear mile (kilometer) as specified. The unpainted spaces between the stripes are included in the overall measurement, if the Plan ratio is not interrupted. Measurement begins and ends on a stripe.

C. Payment by Square Yard (Meter)

When preformed pavement markings are paid for by the square yard (meter), the number of square yards (meters) covered is measured. The space between the markings is included in the overall measurement. The color, width, and type are according to the Plans.

D. Preformed Plastic Word or Symbol

Each preformed plastic word or symbol, complete according to Plan dimensions, is measured by the unit. The code for each word or symbol is stated in the Plans.

E. Removing Existing Pavement Markings

Measurement and payment for removing pavement markings will be according to [Section 656](#) when shown in the Proposal as a payment Item. Otherwise, removal will not be paid for separately, but will be included in the payment for other Work under this Section.

657.4.01 Limits

General Provisions 101 through 150.

657.5 Payment

Payment in each case is full compensation for applying markings, including adhesives, cleaning, application, and traffic control necessary to complete the Item.

Payment will be made under:

Item No. 657.	Preformed plastic solid pavement markings_____ in (mm), (<u>color</u>), (<u>type</u>)	Per linear foot (meter)
Item No. 657.	Preformed plastic solid pavement markings_____ in (mm), (<u>color</u>), (<u>type</u>)	Per linear mile (kilometer)
Item No. 657.	Preformed plastic skip pavement markings_____ in (mm), (<u>color</u>), (<u>type</u>)	Per gross linear foot (meter)
Item No. 657.	Preformed plastic skip pavement markings_____ in (mm), (<u>color</u>), (<u>type</u>)	Per gross linear mile (kilometer)
Item No. 657.	Preformed plastic pavement markings	Per square yard (meter)
Item No. 657.	Preformed plastic pavement markings, words or symbols (<u>color</u>), (<u>type</u>)	Per each
Item No. 657.	Wet reflective preformed solid pavement markings_____ in (mm), (<u>color</u>), (<u>type</u>)	Per linear foot (meter)
Item No. 657.	Wet reflective preformed solid pavement markings_____ in (mm), (<u>color</u>), (<u>type</u>)	Per linear mile (kilometer)
Item No. 657.	Wet reflective preformed skip pavement markings_____ in (mm), (<u>color</u>), (<u>type</u>)	Per gross linear foot (meter)
Item No. 657.	Wet reflective preformed skip pavement markings_____ in (mm), (<u>color</u>), (<u>type</u>)	Per gross linear mile (kilometer)
Item No. 657.	Wet reflective preformed pavement markings	Per square yard (meter)
Item No. 657.	Wet preformed pavement markings, words or symbols (<u>color</u>), (<u>type</u>)	Per each

657.5.01 Adjustments

General Provisions 101 through 150.

Office of Materials and Research

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA**

SUPPLEMENTAL SPECIFICATION

Add the following:

Section 658—Polyurea Traffic Stripe

658.1 General Description

This work includes furnishing and applying reflectorized traffic line paint according to the Plans and these Specifications.

This Item also includes applying words and symbols according to Plan details, Specifications, and the current Manual on Uniform Traffic Control Devices.

658.1.01 Definitions

Painted Stripes: Solid or broken (skip) lines. The location and color are designated on the Plans.

Skip Traffic Stripes: Painted segments between unpainted gaps on a designated sequence with a ratio of 1:3 [10 ft (3 m) segment and 30 ft (9 m) gap] as specified on the Plans. The location and color are designated on the Plans.

658.1.02 Related References

A. Standard Specifications

General Provisions 101 through 150.

[Section 656—Removal of Pavement Markings](#)

[Section 870—Paint](#)

B. Referenced Documents

[QPL 46](#)

AASHTO M 247

ACI Method 503

ASTM C 4060

ASTM D 711

ASTM D 1155

ASTM D 1213

ASTM D 4061

ASTM D 6359

ASTM E 303

ASTM E 1710

ASTM G 154

658.2 Materials

A. General Requirements

- Use polyurea material that has been evaluated (2 year field evaluation) by the National Transportation Product Evaluation Panel (NTPEP) test facility or other approved test facility.
- Use polyurea material produced from an approved source listed on [QPL 46](#).
- Use a polyurea composition that is specifically formulated for use as a durable pavement marking material and for application at elevated temperatures not exceeding 170 °F (77 °C).
- Ensure the liquid markings consist of a two-component (Part A and Part B), 100% solids polyurea film formulated and designed to provide a simple volumetric mixing ratio as recommended by the manufacturer.
- Use white or yellow films for the markings. Ensure that these films are manufactured without the use of lead chromate pigments or other similar, lead-containing chemicals.
- Ensure that the white polyurea contains not less than 13% by weight rutile titanium dioxide pigment to insure adequate opacity, hiding power, and reflective properties.

B. Glass Beads and Ceramic Reflective Elements

Use glass beads and/or ceramic reflective elements for the reflective media system that ensures the polyurea pavement markings meet the reflectance performance requirements in Subsection 658.2.C.2.

C. Finished Product Requirements:

1. Composition

Ensure that the retroreflective pavement markings consist of a mixture of high-quality resins, curing agent and pigments, with a reflective layer bonded to the top surface consisting of glass beads.

2. Reflectance

When applied according to the manufacturer’s recommendations, ensure that the white and yellow markings have the average initial and 12 months retroreflectance values shown in the tables below, as measured in accordance with the testing procedures of ASTM D4061 or ASTM E 1710.

An observation angle of 1.05° and an entrance angle of 88.8° corresponds to 30 meter geometry. The photometric quantity to be measured is the coefficient of retroreflected luminance (R_L) and is expressed as millicandelas per square foot per foot-candle $[(mcd \cdot ft^{-2}) \cdot fc^{-1}]$. The metric equivalent is expressed as millicandelas per square meter per lux $[(mcd \cdot m^{-2}) \cdot lx^{-1}]$.

Determine the initial and 12 months retroreflectance of a single installation according to the measurement and sampling procedures outlined in ASTM D 6359, using a 30-meter retroreflectometer.

Average Minimum Initial Reflectance		
	White	Yellow
Entrance Angle	88.8°	88.8°
Observation Angle	1.05°	1.05°
Retroreflected Luminance $R_L [(mcd \cdot ft^{-2}) \cdot fc^{-1}]$	600	400

Measure initial performance of pavement markings within 7 days after application.

Average Minimum Reflectance at 12 Months		
	White	Yellow
Entrance Angle	88.8°	88.8°
Observation Angle	1.05°	1.05°
Retroreflected Luminance $R_L [(mcd \cdot ft^{-2}) \cdot fc^{-1}]$	400	250

3. Color

Meet these color requirements:

- White markings are pure white and free from dirt or tint.
- Yellow markings are “Federal Yellow” in color.
- The material does not change its color and brightness characteristics after prolonged exposure to sunlight.

4. Skid Resistance

Ensure the surface of the retroreflective marking provides an initial average skid resistance value of 45 BPN when tested according to ASTM E303.

5. Color and Weathering Resistance

Ensure that the mixed polyurea compound, both white and yellow, when applied to 3 in (75 mm) x 6 in (150 mm) aluminum panels at 15 ± 1 mils ($0.381 \text{ mm} \pm 0.025 \text{ mm}$) wet thickness without glass beads and exposed in a Q.U.V. Environmental Testing Chamber, as described in ASTM G-53-77, conforms to the following minimum requirements:

- The color of the white polyurea compound is not darker than Federal Standard No. 595A-17778.
- The color of the yellow polyurea compound meets the requirements of the “Federal Yellow” color chart.

6. Drying Time (Laboratory)

When tested in accordance with ASTM D-711 the polyurea marking material shall reach a no-pick-up condition in 10 minutes or less. Perform this test with ASHTO M247 Type 1 beads applied at a rate of 0.099 pounds per square foot (0.483 kg/m^2). Ensure that the drying time does not increase substantially with decreasing temperature.

7. Drying Time (Field)

When installed at 77 °F (25 °C), at a wet film thickness of 20 ± 2 mils ($0.508 \text{ mm} \pm 0.051 \text{ mm}$) and reflectorized with glass beads and/or ceramic reflective elements, ensure that the polyurea markings reaches a no-track condition in less than 10 minutes. Dry to “no-tracking” will be considered as the condition where no visual deposition of the polyurea marking to the pavement surface is observed when viewed from a distance of 50 feet (15 m), after a traveling vehicle’s tires have passed over the marking.

8. Abrasion Resistance

Ensure that the wear index of the polyurea compound does not exceed 0.00026 lbs (120 mg) when tested in accordance with ASTM C4060 using a CS-17 wheel and under a load of 2.2 lbs (1000 g) for 1000 cycles.

9. Adhesion to Concrete

Ensure that the polyurea pavement marking materials, when tested according to ACI Method 503, have such a high degree of adhesion to the specified concrete surface that there is a 100% concrete failure in the performance of this test. Condition the prepared specimens at room temperature 75 ± 2 °F (24 °C) for a minimum of 24 hours and maximum of 72 hours prior to the performance of this test.

10. Adhesion to Asphalt

Ensure that the polyurea pavement marking materials, when tested according to ACI Method 503, have such a high degree of adhesion to the specified asphalt surface that there is a 100% asphalt failure in the performance of this test. Condition the prepared specimens at room temperature 75 ± 2 °F (24 °C) for a minimum of 24 hours and maximum of 72 hours prior to the performance of this test.

658.3 Construction Requirements

658.3.01 Equipment

A. Traveling Traffic Stripe Painter

To apply the traffic marking material, use a mobile, truck mounted and self contained pavement marking machine, specifically designed to apply two-component liquid materials, and glass beads, in a continuous and skip-line pattern.

Apply the two-component liquid materials through airless impingement mixing guns. The guns must accommodate a plural component material system at the manufacturer’s recommended volumetric mixing ratio.

The guns must have the capacity to deliver materials from approximately 1.5 (5.7 L) to 3 gal (11.4 L) per minute to compensate for a typical range of application speeds of 3 mph (5 km/h) to 6 mph (10 km/h). Ensure that the machine travels at a uniform rate of speed both uphill and downhill.

Select the necessary accessories such as spray tip, mix chamber or static tube, and rod diameter to ensure proper mixing.

Ensure that the machine meets the following:

- The machine is capable of applying three separate stripes, either solid or skip, in any specified pattern by utilizing three adjacent spray nozzles at the same time.
- Each nozzle is equipped with satisfactory cutoff valves that will apply skip lines automatically.
- The application equipment is maneuverable to the extent that straight lines can be followed and normal curves can be made in a true arc.
- The truck-mounted unit is provided with accessories to allow for the marking of symbols and legends.

Ensure that the mobile applicator also includes the following features:

- The mobile applicator provides individual material reservoirs for the storage of Part A and Part B of the resin composition.
- The applicator is equipped with heating equipment of sufficient capacity to maintain the individual resin components at the manufacturer's recommended temperature for spray application.
- The applicator is equipped with separate temperature controls for each component.
- The applicator is equipped with glass bead dispensing equipment and capable of applying the glass beads at a uniform rate.
- The application equipment is equipped with metering devices or pressure gauges on the proportioning pumps as well as stroke counters to monitor volumetric usage. Ensure that the metering devices or pressure gauges and stroke counters are visible.
- The applicator is equipped with all the necessary spray equipment, mixers, compressors, and other appurtenances to allow for the placement of reflectorized pavement markings in a simultaneous sequence of operations.

B. Cleaning Equipment

Use brushes, brooms, scrapers, grinders, high-pressure water jets, or air blasters to remove dirt, dust, grease, oil, and other foreign matter from painting surfaces without damaging the underlying pavement.

658.3.02 Preparation

Before painting, thoroughly clean pavement surfaces of dust, dirt, grease, oil, and all other foreign matter.

Remove concrete curing compounds on new Portland cement concrete surfaces and existing pavement markings on both concrete and asphalt surfaces.

658.3.03 Construction

A. Atmospheric Conditions

Apply pavement markings only during conditions of dry weather and subsequently dry pavement surfaces. Ensure that the pavement surface temperature and the ambient temperature at the time of installation are both greater than 40 °F (4 °C) and that the relative humidity is not greater than 85%.

B. Alignment

Ensure that the traffic stripe is the specified length, width, and placement. On sections where no previously applied markings are present, ensure accurate stripe location by establishing control points at spaced intervals. The Engineer will approve control points.

C. Application

Apply the pavement markings as follows:

1. Apply the liquid marking material by spray method and according to the manufacturer's installation instructions.
2. Ensure marking configurations are in accordance with the "Manual on Uniform Traffic Control Devices."

3. Place the reflectorized pavement markings only on properly prepared surfaces and at the widths and patterns designated on the Plans. Do not begin marking operations until applicable surface preparation work is completed and approved by the Engineer.
4. Air-blast the surface first, to remove any dirt and residues from the pavement. Then apply the pavement markings as a continuous operation.
5. Heat Component A and Component B to the manufacturer's recommended temperatures.
6. Ensure that mixing of the two components occurs in a static tube or impingement chamber prior to reaching the application spray nozzle.
7. Spray the mixed resin onto the pavement surface at a minimum uniform wet thickness of 20 mils (0.51 mm).
8. Immediately following application, drop the glass beads and/or ceramic reflective elements onto the liquid marking at the application rates recommended by the binder manufacture.
9. The work will be subject to application rate checks for both paint and beads.

Following an application of glass beads, and upon curing, ensure that the resulting marking is an adherent reflectorized stripe of the specified thickness and width that is capable of resisting deformation by traffic.

D. Protective Measures

Protect newly applied paint as follows:

1. Traffic
Control and protect traffic with warning and directional signs during painting. Set up warning signs before beginning each operation and place signs well ahead of the painting equipment. When necessary, use a pilot car to protect both the traffic and the painting operation.
2. Fresh Paint
Protect the freshly painted stripe using cones or other satisfactory devices. Repair stripe damage or pavement smudges caused by traffic according to [Subsection 658.3.04](#).

E. Appearance and Tolerance of Variance

Continually deviating from stated dimensions is cause for stopping the work and removing the nonconforming stripe. (See [Section 656](#).) Adhere to the following measurements:

1. Width
Do not lay stripe less than the specified width. Do not lay stripe more than 1/2 in (13 mm) over the specified width.
2. Length
Ensure that the 10 ft (3 m) painted skip stripe and the 30 ft (10 m) gap between painted segments vary no more than ± 1 ft (300 mm) each.
3. Alignment
 - a. Ensure that the stripe does not deviate from the intended alignment by more than 1 in (25 mm) on tangents or curves of 1 degree or less.
 - b. Ensure that the stripe does not deviate by more than 2 in (50 mm) on curves exceeding 1 degree.

658.3.04 Quality Acceptance

Ensure that stripes and segments of stripes are clean-cut and uniform. Markings that do not appear uniform or satisfactory, either during the day or night, or do not meet Specifications or become marred or damaged by traffic or from other causes, will be corrected at the Contractor's expense.

Sections of painted stripe, words, and symbols placed according to the Plans and Specifications and have dried so that paint will not be picked up or marred by vehicle tires will be accepted. The Contractor will be relieved of responsibility for maintenance on accepted sections.

A. Correction of Alignment

When correcting a deviation that exceeds the permissible tolerance in alignment, do the following:

1. Remove the affected portion of stripe, plus an additional 25 ft (8 m) in each direction.
2. Paint a new stripe according to these Specifications.

Remove the stripe according to [Section 656](#).

B. Removal of Excess Paint

Remove misted, dripped, or spattered paint to the Engineer’s satisfaction. Do not damage the underlying pavement during removal.

Refer to the applicable portions of [Section 656](#).

658.4 Measurement

When traffic stripe is paid for by the square yard (meter), the number of square yards (meters) painted is measured and the space between stripes is included in the overall measurement.

Linear measurements are made on the painted surface by an electronic measuring device attached to a vehicle. On curves, chord measurements, not exceeding 100 linear feet (30 linear meters), are used.

Traffic stripe and markings, complete in place, are measured and accepted for payment as follows:

A. Solid Traffic Stripe

Solid traffic stripe is measured by the linear foot (meter), linear mile (kilometer), or square yard (meter). Breaks or omissions in solid lines or stripes at street or road intersections are not measured.

B. Skip Traffic Stripe

Skip traffic stripe is measured by the gross linear foot (meter) or gross linear mile (kilometer). Unpainted spaces between the stripes are included in the overall measurements if the Plan ratio of 1 to 3 remains uninterrupted. Measurement begins and ends on a stripe.

C. Pavement Markings

Pavement markings, words and symbols completed according to Plan dimensions are measured by the unit.

658.5 Payment

Payment will be full compensation for the work under this Section, including the following:

- Cleaning and preparing surfaces
- Furnishing materials, including paints, beads, and thinners
- Applying, curing, and protecting paints
- Protecting traffic, including providing and placing necessary warning signs
- Furnishing tools, machines, and other equipment necessary to complete the Item

Payment will be made under:

Item No. 658	Solid polyurea traffic stripe, _____ in (mm), (<u>color</u>)	Per linear mile (kilometer)
Item No. 658	Skip polyurea traffic stripe, _____ in (mm), (<u>color</u>)	Per gross linear mile (kilometer)
Item No. 658	Solid polyurea traffic stripe, _____ in (mm), (<u>color</u>)	Per linear foot (meter)
Item No. 658	Skip polyurea traffic stripe, _____ in (mm), (<u>color</u>)	Per gross linear foot (meter)
Item No. 658	Polyurea pavement markings, words, and symbols, (<u>color</u>)	Per each
Item No. 658	Polyurea Traffic stripe, _____ in (mm), (<u>color</u>)	Per square yard (meter)

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA**

SUPPLEMENTAL SPECIFICATION

Section 666—Vertical Drainage Wicks

Delete Subsection 666.2 and substitute the following:

666.2 Materials

A. Drain Fabrication

Ensure the following:

- Use drainage wicks consisting of a band-shaped plastic case, permitting continuous vertical drainage, wrapped in a filter jacket, installed in the ground by displacement methods, and spaced and arranged as shown on the Plans. Ensure drainage wicks are a prefabricated type consisting of a plastic drainage core encased in or integrated with a nonwoven polyester filter jacket. Use a band-shaped drain with an aspect ratio (width divided by thickness) not exceeding 50. Ensure the jacket allows free passage of pore water to the core without loss of soil material or piping. Ensure the core provides continuous vertical drainage.
- Ensure the assembled drains are resistant to wet rot, mildew, bacterial action, insects, salts, acids, alkalis, solvents, or any other ingredients in the site groundwater harmful to the drains. Use drains free from defects, rips, holes or flaws.
- Ensure the filter jacket is capable of resisting all bending, puncturing, and tensile forces imposed during installation and during the design life of the drain. Use a jacket material resistant to localized damage (e.g., punching through the filter by sand or gravel particles) and sufficiently rigid to withstand lateral earth pressures due to embedment and surcharge so the vertical flow capacity through the core will not be adversely affected. Ensure the jacket material is sufficiently flexible to bend smoothly during installation and induced consolidation settlement without damage, and will not undergo cracking or peeling during installation of the drain.
- Ensure the core is a continuous plastic material fabricated to promote drainage along the axis of the vertical drain.

B. Physical Properties

Ensure that the drain meets minimum requirements according to the following:

		Filter
Breaking Load	ASTM D 4632	30 lbs/in width (5 N/mm width)
Mullenburst	ASTM D 751	85 lbs/in ² (585 kPa)
Elmendorf Tear	ASTM D 1424	200 grams
Permeability Coefficient		1x10 ⁻⁴ in/sec (3x10 ⁻³ mm/s)

666.2.01 Delivery, Storage, and Handling

A. Drain Protection

Ensure that the drain is wrapped in burlap or a similar heavy-duty covering during shipment and storage.

B. Storage Protection

Protect the storage area from sunlight, mud, dirt, dust, debris, and detrimental substances.

Office of Materials and Research

Date: November 1, 2002
First Use Date January 1, 2003
Revised April 27, 2004
First Use Date June 1, 2004
Revised October 31, 2005
Revised October 23, 2008
Revised December 14, 2010
Revised April 15, 2011

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA**

SPECIAL PROVISION

Section 700—Grassing

Delete Section 700 and substitute the following:

700.1 General Description

This work includes preparing the ground, furnishing, planting, seeding, fertilizing, sodding, and mulching disturbed areas within the Right-of-Way limits and easement areas adjacent to the right-of-way as shown on the Plans except as designated by the Engineer to remain natural.

700.1.01 Definitions

General Provisions 101 through 150.

700.1.02 Related References

A. Standard Specifications

[Section 160—Reclamation of Material Pits and Waste Areas](#)

[Section 163—Miscellaneous Erosion Control Items](#)

[Section 718—Wood Fiber](#)

[Section 822—Emulsified Asphalt](#)

[Section 882—Lime](#)

[Section 890—Seed and Sod](#)

[Section 891—Fertilizers](#)

[Section 893—Miscellaneous Planting Materials](#)

[Section 895—Polyacrylamide](#)

B. Referenced Documents

[QPL 33](#)

[QPL 84](#)

700.1.03 Submittals

Submit manufacturer's product expiration date along with written instructions to ensure proper application, safety, storage, and handling of Polyacrylamide products used in The Work.

Section 700—Grassing

700.2 Materials

Use materials that meet the requirements of the following Specifications:

Material	Section
Wood Fiber Mulch	718.2
Agricultural Lime	882.2.01
Seed	890.2.01
Sod	890.2.02
Fertilizer	891.2.01
Plant Topsoil	893.2.01
Mulch	893.2.02
Inoculants	893.2.04
Tackifiers	QPL 33
Anionic Polyacrylamide	QPL 84 & Section 895

A. Seeds

Whenever seeds are specified by their common names, use the strains indicated by their botanical names.

B. Water

Obtain the water for grassing from an approved source. Use water free of harmful chemicals, acids, alkalies, and other substances that may harm plant growth or emit odors. Do not use salt or brackish water.

C. Agricultural Lime

Agricultural lime rates will be based on a laboratory soil test report. The Contractor is responsible for ensuring the tests are performed by an approved laboratory. Provide a copy of test results to the Engineer. Refer to Section 882 Lime and GSP 18 of the Sampling and Testing Inspection manual for additional information on rates, use, handling and sampling procedures.

D. Fertilizer Mixed Grade

Fertilizer analysis and rates will be based on a laboratory soil test report. The Contractor is responsible for ensuring the tests are performed by an approved laboratory. Provide a copy of test results to the Engineer. Refer to Section 891 Fertilizer and GSP 18 of the Sampling and Testing Inspection manual for additional information on rates, use, handling and sampling procedures.

E. Mulch

Use straw or hay mulch according to [Subsection 700.3.05.G](#).

Use wood fiber mulch in hydroseeding according to [Subsection 700.3.05.F.1](#).

700.2.01 Delivery, Storage, and Handling

General Provisions 101 through 150.

700.3 Construction Requirements

700.3.01 Personnel

General Provisions 101 through 150.

700.3.02 Equipment

Use grassing equipment able to produce the required results.

Section 700—Grassing

Never allow the grading (height of cut) to exceed the grassing equipment's operating range.

A. Mulch Material Equipment

Use mulching equipment that uniformly cuts the specified materials into the soil to the required control depth.

B. Hydroseeding Equipment

For hydroseeding equipment, see [Subsection 700.3.05.F](#).

700.3.03 Preparation

General Provisions 101 through 150.

700.3.04 Fabrication

General Provisions 101 through 150.

700.3.05 Construction

Follow the planting zones, planting dates, types of seed, seed mixtures, and application rates described throughout this Section. The Engineer has the authority to alter the planting dates as set forth by a period of 2 weeks. This 2-week period may be applied to either the beginning of the specified planting and/or to the end of the end of the specified planting season.

In general:

- Obtain the Engineer's approval before changing the ground cover type.
- Do not use annual rye grass seeds with permanent grassing.
- Follow the planting zones indicated on the [Georgia State Planting Zone Map](#), below.
- Sod may be installed throughout the year, weather permitting.
- For permanent grassing, apply the combined amounts of all seeds for each time period within each planting zone and roadway location listed in the [Seeding Table](#), below. Do not exceed the amounts of specified seed.

Planting Zone Map



NON-NATIVE GRASS SEEDING TABLE 1
 (Temporary and Permanent Seed Types for Shoulders, Medians and Slopes 3:1 or Flatter)

Common Name	Botanical Name	Class/Type	Rate/Acre	Planting Zone	Planting Dates
Common Bermuda Grass (Hulled)	<i>Cynodon dactylon</i>	Required Permanent Grass	10 (11)	1	April 16 – August 31
Common Bermuda Grass (Unhulled)			10 (11)		
Common Bermuda Grass (Hulled)	<i>Cynodon dactylon</i>	Required Permanent Grass	10 (11)	2,3,4	April 1 – October 15
Common Bermuda Grass (Unhulled)			10 (11)		
Bahaia Grass			<i>Paspalum motatum</i>		
Rye Grass, Millet, Cereal Grass (Oats)	<i>Lolium penne</i> spsp. <i>Multiflorum</i> , <i>Echinochloa cursgalli</i> , <i>Avena sativa</i>	Temporary Grass	50 (56)	1	September 1- April 15
Rye Grass, Millet, Cereal Grass (Oats)	<i>Lolium penne</i> spsp. <i>Multiflorum</i> , <i>Echinochloa cursgalli</i> , <i>Avena sativa</i>	Temporary Grass	50 (56)	2,3,4	October 16- March 31

NON-NATIVE SEEDING TABLE 2
(Temporary and Permanent Seed Types
for back slopes, fill slopes and areas which will not be subject
to frequent mowing, slopes steeper than 3:1)

Common Name	Botanical Name	Class/Type	Rate/Acre	Planting Zone	Planting Dates
Interstate Lespedeza	<i>Lespedeza sericea</i>	Permanent Grass	50(56)	1,2	March 1 – August 31
Weeping Lovegrass	<i>Eragrostis curvula</i>	Temporary Grass	10(11)		
Interstate Lespedeza	<i>Lespedeza sericea</i>	Permanent Grass	75(84)	1,2	September 1- February 28
Tall Fescue	<i>Festuca arundinacea</i>	Temporary Grass	50(56)		
Interstate Lespedeza	<i>Lespedeza sericea</i>	Permanent Grass	50(56)	3,4	April 1 – October 31
Weeping Love Grass	<i>Eragrostis curvula</i>	Temporary Grass	10(11)		
Interstate Lespedeza	<i>Lespedeza sericea</i>	Permanent Grass	50(56)	3,4	November 1 – March 31
Weeping Love Grass	<i>Eragrostis curvula</i>	Temporary Grass	10(11)		

NATIVE GRASS SEEDING TABLE 3

For Non-mowable Slopes or Areas Designated as Permanent Native Grass Plots.

Plant native seed mixes on back slopes, fill slopes and areas which will not be subject to frequent mowing (slopes steeper than 3:1).

Common Name	Botanical Name	Class/Type	Rate/Acre	Planting Zone	Planting Dates
Canada Wild Rye	<i>Elymus canadensis</i>	Cool Season	Minimum 2 (2)	1,2,3,4	October 31 - March 31
Virginia Wild Rye	<i>Elymus virginicus</i>	Cool Season	Minimum 2 (2)	1,2,3,4	October 31 - March 31
Bottle-brush Grass	<i>Hystrix patula</i>	Cool Season	Minimum 2 (2)	1,2,3,4	October 31 - March 31
Little Bluestem	<i>Schizachyrium scoparium</i> (<i>Andropogon scoparius</i>)	Warm Season	Minimum 2 (2)	1,2,3,4	March 31- August 31
Indiangrass	<i>Sorghastrum nutans</i>	Warm Season	Minimum 2 (2)	1,2,3,4	March 31- August 31
Eastern Gama Grass	<i>Tripsacum dactyloides</i>	Warm Season	Minimum 2 (2)	1,2,3,4,1,2,3,4	March 31- August 31
Rice Cut Grass	<i>Leersia oryzoides</i>	Warm Season	Minimum 2 (2)	1,2,3,4	March 31- August 31
Deertongue	<i>Panicum clandestinum</i>	Warm Season	Minimum 2 (2)	1,2,3,4	March 31- August 31
Switchgrass	<i>Panicum virgatum</i>	Warm Season	Minimum 2 (2)	1,2,3,4	March 31- August 31
Woolgrass	<i>Scirpus cyperinus</i>	Cool Season	Minimum 2 (2)	1,2,3,4	October 31 - March 31
River Oats	<i>Chasmanthium latifolium</i>	Cool Season	Minimum 2 (2)	1,2,3,4	October 31 - March 31
Purple Top	<i>Tridens flavus</i>	Warm Season	Minimum 2 (2)	1,2,3,4	March 31- August 31

See plan sheets/plant lists for detailed native seed mix combinations to be applied at a minimum rate total of 10 (11) lbs per acre (kg/hectare) for each combined mix. If the mix is not provided in the plan sheets, use a minimum of 3 species based on planting dates shown above.

HERBACEOUS PLANT SEEDING TABLE 4
(Approved for Riparian Mitigation or for Seed Mixes
on Slopes Steeper than 3:1-Requiring Permanent Planting)

Common name	Botanical name	Class/type	Rate/Acre	Planting Zone	Planting Dates
Joe Pye Weed	<i>Eupatorium fistulosum</i>	Herbaceous Pe	Minimum 2 (2)	1,2,3,4	September 1 – May 1
Ironweed	<i>Vernonia novaboracensis</i>	Herbaceous Perennial	Up to 10(11)	1,2,3,4	March 1 - August 31,
White snakeroot	<i>Ageratina altissima (Eupat rugosum)</i>	Herbaceous Perennial	Up to 10(11)	1,2,3,4	September 1 – May 1
Swamp milkweed	<i>Asclepias incarnata</i>	Herbaceous Perennial	Up to 10(11)	1,2,3,4	March 1 - August 31,
Frost aster	<i>Aster pilosus (Symphyotric)</i>	Herbaceous Perennial	Up to 10(11)	1,2,3,4	September 1 – May 1
Partridge pea	<i>Chamaecrista fasciculata (fasciculata)</i>	Herbaceous Perennial	Up to 10(11)	1,2,3,4	March 1 - August 31,
Lance-leaf coreopsis	<i>Coreopsis lanceolata</i>	Herbaceous Perennial	Up to 10(11)	1,2,3,4	September 1 – May 1
Tall coreopsis	<i>Coreopsis tripteris</i>	Herbaceous Perennial	Up to 10(11)	1,2,3,4	September 1 – May 1
Boneset	<i>Eupatorium perfoliatum</i>	Herbaceous Perennial	Up to 10(11)	1,2,3,4	September 1 – May 1
Sneezeweed	<i>Helenium autumnale</i>	Herbaceous Perennial	Up to 10(11)	1,2,3,4	September 1 – May 1
Swamp sunflower	<i>Helianthus angustifolius</i>	Herbaceous Perennial	Up to 10(11)	1,2,3,4	March 1 - August 31,
Fringed loosestrife	<i>Lysimachia ciliata</i>	Herbaceous Perennial	Up to 10(11)	1,2,3,4	September 1 – May 1
Wild bergamot	<i>Monarda fistulosa</i>	Herbaceous Perennial	Up to 10(11)	1,2,3,4	September 1 – May 1
Mountain mint	<i>Pycnanthemum tenuifolium</i>	Herbaceous Perennial	Up to 10(11)	1,2,3,4	September 1 – May 1
Black-eyed susan	<i>Rudbeckia hirta</i>	Herbaceous Perennial	Up to 10(11)	1,2,3,4	September 1 – May 1
Goldenrod	<i>Solidago nemoralis</i>	Herbaceous Perennial	Up to 10(11)	1,2,3,4	September 1 – May 1
Butterfly Weed	<i>Aesclepias tuberosa</i>	Herbaceous Perennial	Up to 10(11)	1,2,3,4	March 1 - August 31,

For riparian mitigation, use Table 4 for approved riparian herbaceous seed types in combination with Table 3 of native grass seeds..Riparian seed mixes should incorporate a mix of 60% native grass types (see Table 3) and 40% native herbaceous types (see Table 4) applied at a minimum rate total of 10 (11) lbs per acre (kg/hectare) for each combined mix.

TABLE 5: TEMPORARY GRASS - SPECIES, SEEDING RATES AND PLANTING DATES

Species	Rates per 1000 sq. ft.	Rates per Acre	Planting Date By Zone		
			1 & 2	2	3 & 4
Rye (Grain)	3.9 lbs	168 lbs	8/1 - 11/30	8/15 - 12/1	9/1 - 2/28
Ryegrass	0.9 lbs	40 lbs	8/1 - 11/30	9/1 - 12/15	9/15 - 1/1
Rye & Annual Lespedeza	0.6 lbs 0.6 lbs	28 lbs 24 lbs	3/1 - 4/1	2/1 - 3/1	2/1 - 3/1
Weeping Lovegrass	0.1 lbs	4 lbs	3/15 - 6/15	3/15 - 7/15	3/15 - 7/15
Sudangrass	1.0 lbs	60 lbs	4/1 - 8/31	4/1 - 8/31	3/15 - 8/1
Browntop Millet	1.1 lbs	50 lbs	4/1 - 6/30	4/1 - 7/15	4/1 - 7/15
Wheat	3.9 lbs	168 lbs	9/1 - 12/31	9/1 - 12/31	9/15 - 1/31

When stage construction or other conditions prevent completing a roadway section continuously, apply temporary grassing to control erosion. Temporary grassing is used to stabilize disturbed areas for more than sixty (60) calendar days. Temporary grass may be applied any time of the year, utilizing the appropriate seed species and application rate as shown in the chart above. Apply mulch to areas planted in temporary grass at the rate of ¾ inch to 1.5 inches. Do not place slope mats on areas planted in temporary grass.

Section 700—Grassing

A. Ground Preparation

Prepare the ground by plowing under any temporary grass areas and preparing the soil as follows:

1. Slopes 3:1 or Flatter

On slopes 3:1 or flatter, plow shoulders and embankment slopes to between 4 in and 6 in (100 mm and 150 mm) deep.

Plow front and back slopes in cuts to no less than 6 in (150 mm) deep. After plowing, thoroughly disk the area until pulverized to the plowed depth.

2. Slopes Steeper Than 3:1

Serrate slopes steeper than 3:1 according to Plan details when required.

On embankment slopes and cut slopes not requiring serration (sufficient as determined by the Engineer), prepare the ground to develop an adequate seed bed using any of the following methods as directed by the Engineer:

- Plow to a depth whatever depth is practicable.
- Use a spiked chain.
- Walk with a cleated track dozer.
- Scarify.

Disking cut slopes and fill slopes is not required.

3. All Slopes

a. Obstructions

Remove boulders, stumps, large roots, large clods, and other objects that interfere with grassing or may slide into the ditch.

b. Topsoil

Spread topsoil stockpiled during grading evenly over cut and fill slopes after preparing the ground.

Push topsoil from the top over serrated slopes. Do not operate equipment on the face of completed serrated cuts.

4. Riparian Areas, Stream Restoration Areas, and Wetland and Stream Mitigation Areas

For Permanent Grassing in riparian areas, stream restoration areas, and wetland and stream mitigation areas, provide the minimum ground preparation necessary to provide seed to soil contact. Riparian areas may also be seeded using the no-till method. The no-till method is defined by planting permanent grass seeds using a drill-type seeder over existing vegetation without plowing or tilling soil. Ensure that existing vegetation is less than 3 inches in height (this may be achieved by mowing or using a mechanical string trimmer).

B. Grassing Adjacent to Existing Lawns

When grassing areas adjacent to residential or commercial lawns, the Engineer shall change the plant material to match the type of grass growing on the adjacent lawn. The Contract Unit Price will not be modified for this substitution.

C. Temporary Grassing

Apply temporary grassing according to [Subsection 163.3.05.F](#). Determine lime requirements by a laboratory soil test. Refer to seeding Table 5 for species, amounts of seed and planting dates.

In March or April of the year following planting and as soon as the weather is suitable, replace all areas of temporary grass with permanent grass by plowing or overseeding using the no-till method. If the no-till method is used, ensure that temporary grass is less than 3 inches in height (this may be achieved by mowing). Additional mulch will be required only if the temporary grass does not provide adequate mulch to meet the requirements of [Subsection 700.3.05.G](#), “[Mulching](#).”

Temporary grass, when required, will be paid for according to [Section 163](#).

Projects that consist of asphalt resurfacing with shoulder reconstruction and/or shoulder widening: Type II Wood Fiber Blanket is used to stabilize disturbed areas, no till seeding will be used when permanent grassing is applied and the areas will not be re-disturbed.

D. Applying Agricultural Lime and Fertilizer Mixed Grade

Apply and mix lime and fertilizer as follows:

1. Agricultural Lime

Uniformly spread agricultural lime on the ground at the approximate rate determined by the laboratory soil test.

A. Agricultural Lime may be used as filler material in mixed grade fertilizer in lieu of inert material. The use of agricultural lime as filler material is to be shown on the fertilizer bag or invoice from the supplier. Do not deduct any amount of fertilizer when lime is used as filler.

2. Fertilizer Mixed Grade

Uniformly spread the fertilizer selected according to [Subsection 700.2.D](#) over the ground or by use of hydroseeding. For bid purposes base estimated quantities on an initial application of 400 lb/acre of 19-19-19.

3. Mixing

Before proceeding, uniformly work the lime and fertilizer into the top 4 in (100 mm) of soil using harrows, rotary tillers, or other equipment acceptable to the Engineer.

On cut slopes steeper than 3:1, other than serrated slopes, reduce the mixing depth to the maximum practical depth as determined by the Engineer.

Omit mixing on serrated slopes.

4. Riparian Areas, Stream Restoration Areas, and Wetland and Stream Mitigation Areas

Omit the application of lime and fertilizer within riparian areas.

E. Seeding

Prepare seed and sow as follows:

1. Inoculation of Seed

Inoculate each kind of leguminous seed separately with the appropriate commercial culture according to the manufacturer's instructions for the culture.

When hydroseeding, double the inoculation rate.

Protect inoculated seed from the sun and plant it the same day it is inoculated.

2. Sowing

Weather permitting, sow seed within 24 hours after preparing the seed bed and applying the fertilizer and lime.

Sow seed uniformly at the rates specified in the seeding tables. Use approved mechanical seed drills, rotary hand seeders, hydroseeding equipment, or other equipment to uniformly apply the seed. Do not distribute by hand.

To distribute the seeds evenly sow seed types separately, except for similarly sized and weighted seeds. They may be mixed and sown together.

Do not sow during windy weather, when the prepared surface is crusted, or when the ground is frozen, wet, or otherwise non-tillable.

3. Overseeding

Temporary grass areas that were prepared in accordance with [Subsection 700.3.05.A](#), may be overseeded using the no-till method. The no-till method is defined by planting permanent grass seeds using a drill-type seeder over existing temporary grass without plowing or tilling soil and in accordance with [Subsection 700.3.05.C](#).

4. Riparian Seed Mix shall be used when specified in the Plans. A mix of at least three (3) species from Seeding Table 3 (Native Grasses) and at least two (2) species from Seeding Table 4 (Approved Riparian Mitigation - Herbaceous Plants). The seed, shall be applied as Permanent Grassing within those areas designated on the Plans. The kinds of seed, shall be used according to the appropriate Planting Dates given in the tables.

Section 700—Grassing

F. Hydroseeding

Hydroseeding may be used on any grassing area. Under this method, spread the seed, fertilizer, and wood fiber mulch in the form of a slurry. Seeds of all sizes may be mixed together. Apply hydroseeding as follows:

1. Use wood fiber mulch as a metering agent and seed bed regardless of which mulching method is chosen. Apply wood fiber mulch at approximately 500 lbs/acre (560 kg/ha).
2. Prepare the ground for hydroseeding as for conventional seeding in [Subsection 700.3.05.A](#).
3. Use specially designed equipment to mix and apply the slurry uniformly over the entire seeding area.
4. Agitate the slurry mixture during application.
5. Discharge slurry within one hour after being combined in the hydroseeder. Do not hydroseed when winds prevent an even application.
6. Closely follow the equipment manufacturer's directions unless the Engineer modifies the application methods.
7. Mulch the entire hydroseeded area according to [Subsection 700.3.05.F.1](#), above, and [Subsection 700.3.05.G](#), below.
8. Riparian Areas, Stream Restoration Areas, and Wetland and Stream Mitigation Areas may be hydroseeded. When hydroseeding in these areas only use water, seed and wood fiber mulch.

G. Mulching

Except as noted in [Subsection 700.3.05.B](#) and [Subsection 700.3.05.C](#), apply mulch immediately after seeding areas as follows:

Areas with permanent grass seed and covered with slope mats or blankets will not require mulch.

Evenly apply straw or hay mulch between 3/4 in and 1-1/2 in (20 mm and 40 mm) deep, according to the texture and moisture content of the mulch material.

Mulch shall allow sunlight to penetrate and air to circulate as well as shade the ground, reduce erosion, and conserve soil moisture. If the type of mulch is not specified on the Plans or in the Proposal, use any of the following as specified.

1. Mulch with Tackifier

Apply mulch with tackifier regardless of whether using ground or hydroseeding equipment for seeding.

- a. Mulch uniformly applied manually or with special blower equipment designed for the purpose. When using a blower, thoroughly loosen baled material before feeding it into the machine so that it is broken up.
- b. After distributing the mulch initially, redistribute it to bare or inadequately covered areas in clumps dense enough to prevent new grass from emerging (if required).

Do not apply mulch on windy days.

- c. Apply enough tackifier to the mulch to hold it in place. Immediately replace mulch that blows away.

If distributing the mulch by hand, immediately apply the tackifier uniformly over the mulched areas.

- Tackifier: Use a tackifier listed in the Laboratory Qualified Products Manual shall be used at the manufacturer's recommended rates.

2. Walked-in-Mulch

Apply walked-in-mulch on slopes ranging in steepness from 5:1 to 2:1 and treat as follows:

- a. Immediately walk it into the soil with a cleated track dozer. Make dozer passes vertically up and down the slope.
- b. Where walked-in-mulch is used, do not roll or cover the seeds as specified in [Subsection 700.3.05.E.3](#).

3. Apply only wheat straw mulch on Riparian Areas, Stream Restoration Areas, and Wetland and Stream Mitigation Areas after they have been seeded. The wheat straw mulch is to be applied with a maximum thickness of 1 inch.

Section 700—Grassing

H. Sod

Furnish and install sod in all areas shown on the Plans or designated by the Engineer.

1. Kinds of Sod

Use only Common Bermudagrass (Cynodon dactylon) or one of the following Bermudagrass varieties:

Tifway 419
Tifway II
Tift 94
Tifton 10
Midlawn
Midiron
GN-1
Vamont

No dwarf Bermuda types shall be used. Sod shall be nursery-grown and be accompanied with a Georgia Department of Agriculture Live Plant License Certificate or Stamp. Sod shall consist of live, dense, well-rooted material free of weeds and insects as described by the Georgia Live Plant Act.

2. Type And Size Of Sod:

Furnish either big roll or block sod. Ensure that big roll sod is a minimum of 21 inches wide by 52 feet long. Minimum dimensions for block sod are 12 inches wide by 22 inches long. Ensure all sod consists of a uniform soil thickness of not less than 1 inch.

3. Ground Preparation

Excavate the ground deep enough and prepare it according to [Subsection 700.3.05.A](#) to allow placing of sod. Spread soil, meeting the requirements of [Subsection 893.2.01](#), on prepared area to a depth of 4 inches.

4. Application Of Lime And Fertilizer

Apply lime and fertilizer according to [Subsection 700.3.05.D](#) within 24 hours prior to installing sod.

5. Weather Limitation

Do not place sod on frozen ground or where snow may hinder establishment.

6. Install Sod

Install Sod as follows:

- Place sod by hand or by mechanical means so that joints are tightly abutted with no overlaps or gaps. Use soil to fill cracks between sod pieces, but do not smother the grass.
- Stake sod placed in ditches or slopes steeper than 2:1 or any other areas where sod slipping can occur.
- Use wood stakes that are at least 8 in (200 mm) in length and not more than 1 in (25 mm) wide.
- Drive the stakes flush with the top of the sod. Use a minimum of 8 stakes per square yard (meter) to hold sod in place.
- Once sod is placed and staked as necessary, tamp or roll it using adequate equipment to provide good contact with soil.
- Use caution to prevent tearing or displacement of sod during this process. Leave the finished surface of sodded areas smooth and uniform.

7. Watering Sod

After the sod has been placed and rolled or tamped, water it to promote satisfactory growth. Additional watering will be needed in the absence of rainfall and during the hot dry summer months. Water may be applied by Hydro Seeder, Water Truck or by other means approved by the Engineer.

8. Dormant Sod

Dormant Bermuda grass sod can be installed. However, assume responsibility for all sod through establishment and until final acceptance.

9. Establishment

Section 700—Grassing

Sod will be inspected by the Engineer at the end of the first spring after installation and at the time of Final Inspection. Replace any sod that is not live and growing. Any cost for replacing any unacceptable sod will be at the Contractor's expense.

I. Application of Nitrogen

Apply nitrogen at approximately 50 lbs/acre (56 kg/ha) when specified by the Engineer after plants have grown to 2 inches (50 mm) in height.

One application is mandatory and must be applied before Final Acceptance.

Apply nitrogen with mechanical hand spreaders or other approved spreaders capable of uniformly covering the grassed areas. Do not apply nitrogen on windy days or when foliage is damp.

Do not apply nitrogen between October 15 and March 15 except in Zone 4.

1. Riparian Areas, Stream Restoration Areas, and Wetland and Stream Mitigation Areas

Do not apply nitrogen to these areas.

I. Application of Polyacrylamide (PAM)

1. Prepare soil according to project Plans and Specifications prior to applying PAM.
2. Apply PAM according to manufacturer's recommendations and the requirements listed herein.
3. Apply Polyacrylamide (PAM) to all areas that receive permanent grassing.
4. Apply PAM (powder) before grassing or PAM (emulsion) to the hydroseeding operation.
5. Use only anionic PAM.
6. Ensure that the application method provides uniform coverage to the target and avoids drift to non-target areas including waters of the state.
7. Achieve > 80% reduction in soil loss as measured by a rainfall simulator test performed by a certified laboratory (1 hour storm duration, 3 inches (75 mm) rainfall per hour).
8. Ensure uniform coverage to the target area and minimize drift to non-target areas. Apply anionic PAM to all cut and fill slopes, permanently grassed or temporarily grassed, either prior to grassing or in conjunction with hydroseeding operations. Mulch will not be eliminated.
9. Use application rates in accordance with manufacturer's instructions.
10. Do not exceed 200 lbs/acre/year (224 kg/ha/year).
11. Do not include polyacrylamide when planting in Riparian Areas, Stream Restoration Areas, and Wetland and Stream Mitigation Areas

700.3.06 Quality Acceptance

The Engineer may require replanting of an area that shows unsatisfactory growth for any reason at any time.

Except as otherwise specified or permitted by the Engineer, prepare replanting areas according to the Specifications as if they were the initial planting areas. Use a soil test or the Engineer's guidance to determine the fertilizer type and application rate, then furnish and apply the fertilizer.

700.3.07 Contractor Warranty and Maintenance

A. Plant Establishment

Before Final Acceptance, provide plant establishment of the specified vegetation as follows:

1. Plant Establishment
Preserve, protect, water, reseed or replant, and perform other work as necessary to keep the grassed areas in satisfactory condition.
2. Watering
Water the areas during this period as necessary to promote maximum growth.

Section 700—Grassing

3. Mowing

Mow seeded areas of medians, shoulders, and front slopes at least every 6 months. Avoid damaging desirable vegetation.

In addition, mow as necessary to prevent tall grass from obstructing signs, delineation, traffic movements, sight distance, or otherwise becoming a hazard to motorists.

Do not mow lespedezas or tall fescue until after the plants have gone to seed.

4. Do not mow riparian areas, stream restoration areas, or wetland and stream mitigation areas after planting.

B. Additional Fertilizer Mixed Grade

Apply fertilizer based on the initial soil test report at half the recommended rate each spring after initial plant establishment. For bid purposes apply 200 lbs/acre of 19-19-19. Continue annual applications until Final Acceptance. This additional fertilizer will be measured and paid for at the Contract Unit Price for fertilizer mixed grade.

Do not apply additional fertilizer to Riparian Areas, Stream Restoration Areas, and Wetland and Stream Mitigation Areas.

C. Growth and Coverage

Provide satisfactory growth and coverage, ensuring that vegetation growth is satisfactory with no bare spots larger than 1 ft² (0.1 m²). Bare spots shall comprise no more than 1 percent of any given area. An exception is given for seed not expected to have germinated and shown growth at that time.

For wetland and stream mitigation areas, survival rates shall be 80% of typical required growth and coverage.

D. Permissible Modifications

When all Items of the work are ready for Final Acceptance except for newly planted repaired areas or other areas with insufficient grass, the Contractor may fill the eroded areas or treat bare areas with sod obtained, placed, and handled according to [Subsection 700.3.05.H](#).

Carefully maintain the line and grade established for shoulders, front slopes, medians, and other critical areas.

Sod as described above will not be paid for separately, but will be an acceptable substitute for the satisfactory growth and coverage required under this Specification. These areas treated with sod are measured for payment under the Item for which the sod is substituted.

700.4 Measurement

A. Permanent Grassing

Permanent Grassing will be measured for payment by the acre (hectare).

B. Mulches

Straw or hay mulch applied to permanent grassing areas will be measured by the ton (megagram). Wood fiber mulch furnished by the Contractor for permanent grassing is not measured for separate payment.

C. Quantity of Sod

Sod is measured for payment by the number of square yards (meters) , surface measure, completed and accepted.

D. Water

Water furnished and applied to promote a satisfactory growth is not measured for payment.

E. Quantity of Lime and Fertilizer Mixed Grade

Lime and fertilizer are measured by the ton (megagram). Lime used as a filler in fertilizer is measured by the ton (megagram).

F. Quantity of Nitrogen Used for Permanent Grassing

Nitrogen is measured in pounds (kilograms) based on the weight of fertilizer used and its nitrogen content.

Section 700—Grassing

G. Replanting and Plant Establishments

No measurement for payment is made for any materials or work required under [Subsection 700.3.06](#) and [Subsection 700.3.07](#).

H. Temporary Grass

Temporary grass is measured for payment by the acre (hectare) according to [Section 163](#).

I. Riparian Areas, Stream Restoration Areas, and Wetland and Stream Mitigation Areas

Riparian areas, Stream Restoration area, and Wetland and Stream Mitigation areas will be measured by the acre (hectare).

700.4.01 Limits

General Provisions 101 through 150.

700.5 Payment

As grassing and planting progress, the Contractor will receive full measurement and payment on regular monthly estimates provided the work complies with the Specifications.

A. Permanent Grassing

Permanent grassing will be paid for at the Contract Price per acre (hectare), complete and in place. Payment is full compensation for preparing the ground, seeding, wood fiber mulch, polyacrylamide, and providing plant establishment, soil tests and other incidentals.

B. Straw or Hay Mulch

Straw or hay mulch required for Permanent Grassing will be paid for according to [Section 163](#).

C. Fertilizer Mixed Grade

Fertilizer mixed grade will be paid for at the Contract Price per ton (megagram). Payment is full compensation for furnishing and applying the material.

D. Lime

Lime will be paid for at the Contract Price per ton (megagram). Lime used as filler in fertilizer will be paid for per ton (megagram). Payment is full compensation for furnishing and applying the material.

E. Nitrogen

Nitrogen will be paid for at the Contract Price per pound (kilogram) of nitrogen content. Payment is full compensation for furnishing and applying the material.

F. Sod

Sod will be paid by the square yard (meter) in accordance with the following schedule of payments. Payment is full compensation for ground preparation, including addition of topsoil, furnishing and installing live sod, and for Plant Establishment.

1. 70% of the Contract Price per square yard will be paid at the satisfactory completion of the installation.
2. 20% of the Contract Price will be paid upon satisfactory review of sod which is healthy, weed free and viable at the inspection made at the end of the first spring after installation.,.
3. 10% of the contract price will be paid upon satisfactory review of sod that is healthy, weed free and viable at the Final Acceptance.

G. Temporary Grass

Temporary Grass will be paid for under [Section 163](#).

Section 700—Grassing

H. Riparian Areas, Stream Restoration Areas, and Wetland and Stream Mitigation Areas

Riparian areas, Stream Restoration area, and Wetland and Stream Mitigation areas will be paid for at the Contract Price per acre (hectare), complete and in place. Payment is full compensation for preparing the ground, seeding, and providing plant establishment and other incidentals.

Payment will be made under:

Item No. 700	Permanent grassing	Per acre (hectare)
Item No. 700	Agricultural lime	Per ton (megagram)
Item No. 700	Fertilizer mixed grade	Per ton (megagram)
Item No. 700	Fertilizer nitrogen content	Per pound (kilogram)
Item No. 700	Sod	Per square yard (meter)
Item No. 700	Riparian, Stream Restoration, Wetland & Stream Mitigation	Per acre (hectare)

700.5.01 Adjustments

General Provisions 101 through 150.

REVISED 4-15-11

DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA

PROPOSAL

DO NOT UNSTAPLE THIS BOOKLET....ENTER ALL REQUIRED INFORMATION
----- EITHER BY HAND OR BY STAMP.

DATE OF OPENING : April 20, 2012

CALL ORDER : 025

CONTRACT ID : B34313-12-000-0

PCN -----	PROJECTS AND CONTRACT NO. -----
0010290.01000	0010290
0010311.01000	0010311

COUNTY : FORSYTH

FULTON

CODE _____ ISSUED TO:

1. _____
2. _____
3. _____

PART 2 OF 2

THE CONTRACTOR SHALL RETURN ALL PARTS OF THE PROPOSAL
WITH HIS BID UNLESS BIDDING ELECTRONICALLY

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA**

Georgia Department of Transportation
State of Georgia
Special Provision

Section 702—Vine, Shrub, and Tree Planting

702.1 General Description

This Work includes furnishing and planting vines, shrubs, trees and plants, treating regenerated areas, and environmental mitigation planting for riparian buffers and tidal marsh areas.

702.1.01 Definitions

General Provisions 101 through 150.

702.1.02 Related References

A. Standard Specifications

Section 108—Prosecution and Progress

Section 214—Mitigation Site Construction

Section 700—Grassing

Section 882—Lime

Section 891—Fertilizers

Section 893—Miscellaneous Planting Materials

B. Referenced Documents

Standardized Plant Names

ANSI A300 Part 1 Pruning Standards

ANSI Z60.1 American Standards for Nursery Stock

702.1.03 Submittals

A. Certificates of Inspection

Submit certificates of inspection with the invoice for each shipment of plants as required by law for transportation.

File certificates with the Engineer before the material is accepted. Plants may be rejected at the site regardless of Federal or State government inspections at the place of growth.

B. Substitutions

When both primary and alternate plants are specified, use the alternate only after providing written proof that the primary plants specified are not available. In this case a Supplemental Agreement is not required to use the alternate plants.

When a primary or an alternate plant cannot be furnished, provide the Engineer written proof that neither is available. A Supplemental Agreement is required for substitute plants in this case.

Use approved substitute plants, as designated by the Engineer, equal in value to specified plants. Request substitutions at least thirty (30) days before the end of the planting season in the area.

702.2 Materials

Ensure that materials meet the requirements of the following Specifications:

Material	Section
Water	700.2.B
Agricultural Lime	882.2.01
Fertilizers	891.2.01
Plant Topsoil	893.2.01
Landscape Mulch	893.2.02
Vines, Shrubs, Trees, and Miscellaneous Plants	893.2.03
Tree Paint	893.2.06
Prepared Plant Topsoil	893.2.07
Stakes	893.2.08
Organic Soil Additives	893.2.09

A. Plant Specifications

Furnish plants according to the plant name and Specifications included on the plan sheets..

1. Plant Names

Ensure that the botanical and common names of plants specified conform with the most current edition of Standardized Plant Names, as adopted by the American Joint Committee on Horticultural Nomenclature.

2. Plants should be clearly labeled at the nursery. Labels should remain on the plants until inspected by the engineer. Grades

Ensure that plants meet the grade requirements of the most current American Nursery and Landscape Association ANSI Z60.1 and any other requirements.

Caliper used for establishing plant grades or trunk sizes is measured according to the American Nursery and Landscape Association ANSI Z60.1. Plant trees with straight stems and symmetrical branches according to their natural growth. Trees with broken or damaged terminal or main stems will be rejected. There shall be a single dominant leader to the top of the all large canopy shade trees. There can be a double leader in the top 10% of the tree height.

Trees should be rooting into the root ball so that soil or media remains intact and trunk and root ball move as one when lifted, but not root bound. The trunk should bend when gently pushed and should not be loose so it pivots at or below the soil line.

There shall be no roots greater than 1/10 diameter of the trunk circling more than one-third the way around in the top half of the root ball. Roots larger than this may be cut provided they are smaller than one-third the trunk diameter.

The leaf-bearing crown should be full and uniform. Leaves should show no evidence of chlorosis, necrosis, disease or insect infestation.

3. Bare root seedlings

Use nursery-grown bare root seedlings which are a minimum of three (3) feet (1 meter) in height above the ground with a 1/4 inch (6.35mm) caliper, and a minimum primary root length of five inches (5) unless specified differently on the plan drawings.

Use approved substitute plants, as designated by the Engineer, equal in value to specified plants. Request substitutions at least 30 calendar days before the end of the planting season in the area.

B. Nursery Plants

Unless otherwise specified, use plants stock-grown in a licensed nursery under intensive care and cultivation for at least one year. The largest branches of shade trees should be spaced at least 6 inches apart. The branch system shall be normally developed and free of disease, injurious insects, disfiguring knots, sun-scald, injuries, bark abrasions, dead or dry wood, broken terminal growth, or other disfigurements. Stems should show no evidence of die-back. Ensure that proper certificates of inspection and a complete list of the nursery growers accompany nursery grown plants. See Subsection 893.2.03.

C. Approval and Selection of Materials and Work

Select materials and execute operations required under the Specifications and drawings with the approval of the Engineer. Remove rejected materials from the site promptly.

702.2.01 Delivery, Storage, and Handling

A. Bare-Rooted Plants

Protect bare root plants from drying out until planted. Uncovered roots without moisture-loss gel coating shall be exposed to air no longer than 15 minutes.

B. Balled and Burlapped Plants (B&B)

1. Burlap shall be a natural biodegradable material. Do not use synthetic burlap.
2. Replace plants rejected because of broken or loose balls, or balls of less diameter than that specified.
3. Protect the roots of balled and burlapped plants from moisture loss, unless they are planted immediately after they are delivered.
4. Plants shall be harvested with the ball of earth in which they are growing intact.

C. Container-Grown Plants

Keep container-grown plants moist but well drained until planted. Handle plants by the container or soil ball and not by the top growth.

D. Heeled-in Plants

Properly maintain heeled-in plants until they are planted. Do not allow plants to remain heeled-in over the summer or for over 30 days without the Engineer's consent.

E. Injury Prevention

Injured plants will be rejected. Protect tops of shrubs and trees while in transit to prevent windburn.

F. Live Willow Stake Material

Live stakes shall be moistened, capable of rooting, without injury and stripped of all stems and leaves with a minimum of scarring. The stakes shall be from 5 to 8 feet (1.5m to 2.4m) in length with a basal end of 0.5 to 1.5 inches (1,27cm to 3.8cm) in diameter. The top ends shall be blunt and cut square and the butt ends angled.

702.3 Construction Requirements

702.3.01 Personnel

General Provisions 101 through 150.

702.3.02 Equipment

General Provisions 101 through 150.

702.3.03 Preparation

A. Inspect Plant Material Before Digging

The Engineer will inspect trees or plants from the bidder's source for acceptability and conformity to specification requirements for approval by the Engineer. When rejecting the trees or plants, the Engineer reserves the right to pursue and examine other sources of plants to find acceptable specimens. This change will not constitute an increase in cost to the State.

B. Clear and Grub

Clear and grub the planting area before planting or beginning to prepare the plant bed, unless noted differently on the plans. See Section 201.

C. Prepare Plant Bed

Prepare for planting as follows:

1. Planting Limits

Stake planting limits according to Plan details and the Engineer. Have the Engineer approve the method of plant identification before planting.

For median plantings, keep any woody plant a minimum of 3 feet (1m) from the edge of the plant bed to avoid vegetative growth into the roadway.

For stream buffers identified as "Stream Buffer", on plans, the plant species shall be planted in a random, intermixed manner throughout the entire planting area. At the edges of the planting zone, keep new plants a minimum of 8 feet (2.4m) from existing trees or permanent structures.

2. Applications of Soil Additives

a. Apply fertilizer and lime to the plant bed according to the soil test report.

b. Spread an organic soil additive, (See Subsection 893.2.09), evenly throughout the designated area to at least 2 in (50 mm) deep. Thoroughly dig it into the soil to at least 6 in (150 mm) deep using a rotary hoe type tiller or other equipment that evenly mixes the soil, lime, fertilizer, and organic soil additive.

c. Till the area until the surface is smooth and free of weeds, roots, rocks, and other debris, to the satisfaction of the Engineer.

d. If the planting area lies within a stream buffer, wetland, or marsh the addition of fertilizer or lime is prohibited.

702.3.04 Fabrication

General Provisions 101 through 150.

702.3.05 Construction

A. Seasonal Limitations for Planting

For geographic seasonal limitations, refer to the Planting Zones Map found in Subsection 700.3.05. Plant in Zones 1 and 2 between October 15 and March 15. Plant in Zones 3 and 4 between November 1 and January 1.

B. Planting Operations

Plant using the method called for on the details and plan sheets. Before beginning planting of each area, have available the necessary materials including prepared plant topsoil (see Subsection 893.2.07), water, stakes, and mulch. Plants shall be installed as straight/upright as possible. Any plants found to be leaning or broken will not be accepted or paid for by the engineer.

When seasonal limitations and weather conditions permit, continuously water, mulch, guy, provide tree guards, and stake as indicated on the plans and details until completing the last operation.

After completing planting, provide a method for retaining water adjacent to the plant according to the details shown on the Plans or as directed by the Engineer.

Protect marsh restoration areas from vehicles and machinery. Typical protective barriers are not to be used in tidal areas. Stakes that remain secure and are taller than the highest tide, flagged with highly visible flagging tape, are required to mark the area to be protected and off-limits for vehicles and machinery.

1. Planting By the Pit Method

a. Placing Bare-Rooted Plants

Plant bare-rooted plants delivered to the pit area. Protect roots from drying out until placing them in the pit.

1. Center plants in pits and spread roots as they originally grew.
2. Cover and prepare the topsoil according to details shown on the Plans.

b. Placing Balled and Burlapped Plants

Immediately plant these plants after they are delivered to the pit site.

1. The pit diameter shall be a minimum of 3 times the diameter of the rootball. Center the ball in the prepared pit, leaving the top of the ball 1 in (25 mm) above the top of the ground for settlement.
2. Cut away and remove the top 1/3 of burlap from the rootball. Cut all ropes and twine, pull the nails, and drop the remaining burlap to the bottom of the hole. Cut away and remove all wire from the root ball.
3. Partially fill the pit with prepared plant topsoil and compact the soil enough to hold the ball firmly. Add mycorrhizal inoculant to plant topsoil if specified in plans.

c. Placing Container-Grown Plants

When the container is delivered to the pit site, split the container from top to bottom and carefully remove the plant.

1. The pit diameter shall be a minimum of 3 times the diameter of the rootball. Spread into the hole any major roots growing around the container or prune them to remove any circular growth.
2. Place the ball in the center of the prepared pit, leaving the top of the ball 1 in (25 mm) above the top of the ground for settlement.
3. Partially fill the pit with prepared plant topsoil and compact the soil enough to hold the ball firmly. Add mycorrhizal inoculant to plant topsoil if specified in plans.

d. Completing Pit Plantings

After placing pit plantings, water plants thoroughly the same day regardless of weather or soil moisture conditions.

1. After the water has soaked in, add prepared plant topsoil and compact firmly up to 2 in (50mm) below the adjacent ground.
2. Stop compacting when the compacted prepared topsoil is 2 in (50 mm) below the adjacent ground.
3. Fill the remainder of each pit with loose, prepared plant topsoil according to the details shown on the Plans.
4. Prepare the loose topsoil to retain water adjacent to the plant according to the Plans or as directed by the Engineer.

e. Live Stake Plantings

1. Plant live willow stakes at four (4) –foot (1.2m) intervals or as indicated on the drawings with the buds facing upward.
2. Eighty (80) percent of the stake shall be installed below ground, leaving twenty (20) percent extending above ground.
3. Stakes shall be placed deep enough to reach the water table during the dry season at an angle perpendicular to the slope.
4. Pack soil firmly around the hole after installation.

5. Install live willow (*Salix spp.*) stakes only in the dormant season, according to the planting details and landscape plan notes.
 6. Replace any live stakes that split during installation.
2. Planting using a Dibble, Hoedad, or Reinforced Planting Shovel for Bare Root Seedlings.
Planting shall only be done when there is adequate moisture in the ground and when the ground is not frozen.
Provide proper root positioning and contact with the soil, and eliminate all air pockets around roots. Roots of seedlings shall not be pinched or bent in a sideways or upturned direction.
Each tree shall be inserted into the hole such that the root collar of the tree will be at ground level after backfilling is complete. Allowance for burying the root collar below ground level shall not exceed one-half inch in depth. In no case shall planting result in the root collar remaining above ground level. The soil back-filled around the root system shall be compacted sufficiently to support the sapling. Mow or use a string trimmer to a height of 1 in (25 mm) in the area designated for restoration.
Grass the area designated for restoration with a riparian seed mix and apply wheat straw mulch to the area before planting seedlings.
Plant within 48 hours after mowing or string trimming the site.
 3. Restoration and enhancement of tidal marsh areas are subject to possible wave energy, requiring the use of a plant anchor for each plant. See planting plan sheets and details for plant anchor and anchoring descriptions.

C. Landscape Mulching

1. For Pit Plantings
Follow these requirements when mulching for pit plantings:
 - a. Where the distance between plants is 8 ft (2.4 m) or less, spread mulch throughout and 3 ft (900 mm) beyond the outermost plants. Where plants are more than 8 ft (2.4 m) apart, apply mulch in a circular fashion around each plant, forming a ring 5 ft (1.5 m) in the outside diameter.
If plant pits are greater than 5 ft (1.5 m) in diameter, ensure that the mulch extends out to cover the berm as shown in the planting details on the Plans.
 - b. Apply mulch within 3 days of planting at least 4 in (100 mm) in depth to obtain a compacted depth of at least 3 in (75 mm).
Compaction occurs naturally. Check compaction at least two months after spreading and exposing the mulch to the elements.
If the compacted depth is less than 3 in (75 mm), apply additional mulch to deficient areas within 1 month following notification.
 - c. Apply mulch to a uniform depth and remove lumps for a neat appearance. Tuck mulch neatly against all paving edges, drainage structures, and where planting beds meet grassed areas.
 - d. Leave a 1 in (25 mm) to 2 in (50 mm) ring of non-mulched area directly around all tree trunks.
 - e. Do not mulch with Cypress Mulch.
2. For Plantings using a Dibble, Hoedad, or Reinforced Shovel
Apply landscape mulch according to Subsection 702.3.05.C.1 with the following exceptions:
 - a. Apply mulch before planting.
 - b. Use only wheat straw mulch in restoration areas.
 - c. Ensure that the mulch coverage is open enough to allow seed germination to take place and dense enough to conserve moisture in the seed bed.
3. For Stream Buffer Restoration Planting Areas wheat straw shall be the only types of mulch used.

4. Do not use mulch in a tidal marsh area.

D. Wrapping

Do not wrap the trunks of tree unless specified in the plans. When wrapping is specified, tightly wrap the trunks of deciduous trees over 1.25 in (32 mm) in caliper. Wrap in strip burlap or waterproof crepe tree wrapping paper or other approved materials.

1. Begin wrapping at the ground and extend spirally up and beyond the first rosette of branches with an overlap of one half the width of the wrapping material.
2. Tie the wrapping material securely with binder twine spaced every 12 in (300 mm) for the full length of the wrapping. Wrap immediately after planting.

E. Staking and Guying

1. Do not use staking and guying unless specified in the plans or details.

2. **Perimeter Staking**

Place perimeter stakes 2 in x 2 in x 36 in (50 mm x 50 mm x 900 mm). Stake the perimeter of indicated regenerated areas within specified planting dates according to the Plans or as directed by the Engineer. Keep staking for tidal marsh areas secured with supports taller than the highest tide with highly visible flagging tape to mark the area as off-limits for vehicles and machinery.

3. **Vine, Shrub, and Miscellaneous Plant Staking**

Use stakes to identify isolated vines, shrubs, and miscellaneous plants outside of solid mulched beds according to Plan details.

4. **Tree Staking and Guying**

Stake trees using a system that will prevent trees from leaning or tilting and keep the root ball stable until the roots become anchored. The system should allow the top some movement and flexibility without damaging the tree.

F. Pruning

1. Prune plants on the site before planting and after initial inspection by the Engineer as needed for the health of the plant. Never prune severely to get plants to meet Specifications.
 - a. Follow ANSI A300 Part 1 standards and use approved tools designed for pruning. Lopping, topping, or shearing trees or shrubs is not permitted.
 - b. Prune back damaged, scarred, frayed, split, and skinned branches, limbs, and roots to live wood nearest to the next sound, outside lateral bud, branch, limb, or root.
 - c. Leave the terminal leaders or buds in trees intact.
 - d. Prune roots, when necessary, as directed by the Engineer.
 - e. Prune Crape Myrtles to maintain natural form only. Severely cutting back or stump pruning crape myrtles is not permitted. Remove sucker growth from Crape Myrtles.
 - f. Damaged, scarred, frayed, split and skinned branches, limbs and roots shall be pruned back to live wood nearest to the next viable outside lateral bud, branch, limb or root.

G. Watering

1. Apply water in a manner to prevent erosion. Water plants deeply and thoroughly at the time of planting. Water after applying fertilizer called for in Subsection 702.3.05.H and as necessary to maintain enough moisture to promote plant growth. Use water reservoir bags if specified in plans or details.
 - a. Apply enough water to wet the soil to a depth slightly below the roots. Direct the water to the ground around the plant, not the tops.
 - b. Do not allow plant foliage to dry out or plants to defoliate from lack of water. Remove plants in such condition from the site immediately. Apply supplemental watering to maintain vigorous growth and to keep plants moist and as directed by the Engineer.

- c. Apply water once per week throughout the planting season in which the plants are installed. Follow Subsection 702.3.07.B and 702.3.07.C for shrub and tree watering requirements throughout the life of the project.

H. Spring Application of Fertilizer

1. Method and Rate of Application

Follow these requirements when applying fertilizer in the spring:

a. Trees

Apply a slow-release fertilizer according to soil test results. Assume 8-12-12 with a rate of 1 cup (0.25 L) per caliper inch of tree for bidding purposes.

b. Shrubs and vines

Fertilize shrubs according to soil test results with a slow release fertilizer by spreading fertilizer around the base of the plant and working it into the soil by hand. Assume 6-12-12 with a rate of 0.5 cup (0.12 L) per foot of shrub height for bidding purposes.

Bed Areas

Spread fertilizer on bed areas (defined by method of planting in Subsection 702.3.05.B), over the mulch according to soil test results. Assume 3 lbs/100ft² of 6-12-12 for bidding purposes. Thoroughly water in the plants.

c. Stream Buffer Areas

The addition of fertilizer or lime is prohibited within the stream buffer planting area.

d. Tidal March Areas

The addition of fertilizer or lime is prohibited within marsh areas.

2. Time of Spring Fertilizer Application

Apply fertilizer in the spring in Zones 1 and 2 (with reference to the Planting Zones specified in Subsection 702.3.05.A) between April 1 and April 15. Apply between March 15 and April 1 for Zones 3 and 4.

For late plantings, do not apply fertilizer less than 30 days after the plantings.

3. Additional Fertilizer

Approximately one month after the spring fertilizer is applied; the Engineer will inspect planted areas and determine if an additional application of fertilizer is needed for any plant or group of plants.

If the Engineer determines additional fertilizer is required, apply fertilizer according to soil test results between June 15 and July 15th.

I. Tree Guards for Stream Buffer Saplings

Each planted bare root, sapling-sized plant shall be fitted with a tree guard to protect the saplings from wildlife browsing. The tree guards shall be at least 36 inches tall, with appropriately sized wooden stakes or bamboo to securely support the tree guard [i.e., a 4-foot (1.2 meter) stake for a 36 inch (914.4 mm)guard]. Mesh tube-type tree guards are required. Vexar tubes, or equivalent, are to be used. All tree guards shall be removed from the saplings at final inspection.

J. Restoration and Cleanup

Restore areas where existing grass has been damaged or scarred during planting operations at no expense to the Department. Restore the disturbed areas to their original conditions as directed by the Engineer. Clean up debris, spoil piles, and containers and leave the Project area clean.

Clean up and remove all debris, spoil piles, containers, water reservoirs, trash, etc. and leave the project area in an acceptable condition. Inspect all installed erosion control devices weekly and clean out or repair as required. Remove all erosion control devices at final acceptance unless otherwise instructed by the Engineer.

702.3.06 Quality Acceptance

Preserve the plants in a healthy growing condition and keep plants moist, particularly during drought conditions (no rain for any two week period). The acceptability of the plant material planted and maintained as specified will be determined at the end of an establishment period.

The plant establishment period is the period from the last planting specified in Subsection 702.3.05.B until the following October 1. Plant all plants in one planting season unless otherwise approved by Engineer.

A. First Establishment Period

At the end of the first planting season, the first establishment period begins. The Department will make the first semi-final inspection 30 days before the end of the first establishment period. Replace dead, dying, diseased, unsatisfactory, and missing plants, by January 20 of the next (second) planting season. For stream buffer areas, all replacement plants shall be tagged with 18 inch (457.2 mm) lengths of brightly-colored survey tape. Tree guards shall be placed around all replacement saplings. All costs for replanting, tagging and tree guards for replacement trees shall be included in the contract price bid for the original planting.

B. Second Establishment Period

At the end of the second planting season, the second plant establishment period begins. The Department will make the second semi-final inspection 30 days before the end of the second establishment period. Again, replace dead, dying, diseased, unsatisfactory, and missing plants, by January 20 of the next (third) planting season. For stream buffer areas, all replacement plants shall be tagged with 18 inch (457.2 mm) lengths of brightly-colored survey tape. Tree guards shall be placed around all replacement saplings. All costs for replanting, tagging and tree guards for replacement trees shall be included in the contract price bid for the original planting.

C. Final Inspection

The Department will make the final inspection of the plants during May, following any needed replacements during the previous planting season. Assume responsibility for the plants until the Final Acceptance of the Project or a portion of the Project.

702.3.07 Contractor Warranty and Maintenance

Project maintenance includes, but is not limited to, watering, cultivating, weeding, pruning, repairing, adjusting guys and stakes, and performing other work as ordered by the Engineer until final acceptance.

Promptly remove from the Project area dead plants or those that no longer conform to the requirements of Subsection 702.2.A.2.

Mow the entire right-of-way within the limits of the Project up to a maximum of four times per calendar year. Do not mow riparian mitigation sites.

A. Leaning Trees

Straighten leaning trees as directed by the Engineer. Follow Staking and Guying requirements for replacements or repairs as per Subsection 702.3.05.E.

B. Shrub Maintenance

1. Pruning

Prune dead or diseased limbs to provide for plant health and appearance as directed by the Engineer.

2. Landscape Mulching

Continuously maintain shrub and tree beds with a clean, freshly mulched appearance using the mulch originally specified. See Subsection 702.3.05.C. Do not mulch shrub and tree beds within riparian mitigation sites.

- a. Apply a 2 in (50 mm) loose layer of specified mulch (top-dressing) on top of all areas, including tree pits, initially mulched, at the following times:
 1. In August, during the first plant establishment period.
 2. In April, during the second plant establishment period.
 3. In August, during the second plant establishment period.
 4. In April, prior to the final inspection.
3. Applying Fertilizer
See Subsection 702.3.05.H.
4. Applying Pesticides
 - a. Inspect all planted or seeded vegetation for insects, grubs, mites, diseases, etc., once every two weeks. Apply insecticides, fungicides, and herbicides according to the manufacturer's recommendations to effectively control or eradicate the problem.
 - b. Perform all pesticide applications under the direct supervision of a trained licensed commercial pesticide operator whose license includes subcategory 27 – Right of Way Pest Control. Carry the pesticide license/certification on the work site during applications. Carry all labeling associated with the chemical being applied at the work site.
 - c. Submit all product information data sheets and EPA approval numbers on all pesticides proposed to be used prior to application for approval.
 - d. Notify the Engineer a minimum of 48 hours prior to any and all pesticide applications.
 - e. Add a blue dye to all spray applications unless approved otherwise by the Engineer.
 - f. Monitor the weather and spray under proper weather conditions. Spraying shall not occur when the weather is greater than 10 miles per hour.
 - g. Wear the proper safety attire. Wear long sleeve shirts, long pants, gloves, and safety glasses. Wear or use any additional protective safety attire or gear as recommended by the product's manufacturer.
 - h. Repair any damage that is a result of mishandling or misuse of materials, at no expense to the Department, to the satisfaction of the Engineer.
 - i. For stream buffer and marsh restoration areas, pesticides are not to be used unless approved by the Department Ecology Manager.
5. Edging
 - a. Edge all shrub pits, shrub beds, and tree pits once a month throughout the life of the project such that the vee-cut edging detail specified on the plans is maintained. Prevent grass and weeds from growing over or into the shrub beds and tree pits.
 - b. Use equipment specifically designed for edging. Line trimming equipment shall not be used.
6. Watering
 - a. Check all planted material once a week throughout the contract for dryness by removing the mulch from their base and "sampling the soil" approximately 4 in (100mm) deep. Water if the soil is not moist.
 - b. Water all planted material if a drought (no rain for two weeks) occurs. Provide the water required to meet the watering requirements.
 - c. Water each plant thoroughly until the ground is saturated to a depth slightly below the root ball. Apply water in a manner to prevent erosion.
7. Weed Control
Perform weed control throughout the project, a minimum of once every two weeks, in all areas within the project limits to maintain tree pits, shrub beds, sidewalks, curb and gutter, walkways, ditch paving, concrete medians, and other pavement weed free. Meet the following conditions:
 - a. Perform weed control to prevent weeds from becoming established, setting seed, or from becoming visible in the planting beds.

- b. Completely remove all undesirable plants (weeds) by hand pulling. Removal of weeds may be accomplished using herbicides if approved by the Engineer. However, the use of herbicides is prohibited in stream buffer areas unless approved by the Department Ecology Manager.
 - c. Apply an approved pre-emergent herbicide twice each year, once in the spring and once in the fall, throughout the contract. The use of pre-emergent herbicides is prohibited in stream buffer areas. Apply pre-emergent to all shrub beds and tree pits. Notify the Engineer 48 hours prior to spraying. Use a blue dye in all applications unless approved otherwise by the Engineer.
 - d. Eradicate all invasive exotic pest plants found within the project limits throughout the life of the project, including stream buffer and marsh areas. Volunteer, non-invasive plant material within stream buffer restoration areas is acceptable.
 - e. Dispose off site on a daily basis all weed, exotic plants, clippings, litter, and debris generated.
8. Policing
Remove debris such as paper, broken limbs, bottles, cans, etc., a minimum of the first and third week of each month from all areas within the project limits while maintaining the site.
9. Mitigation Areas
Pruning, mulching, edging, and applying spring fertilizer are not required within stream buffer and regenerated forest areas.

C. Tree Maintenance

- 1. Watering
See Subsection 702.3.07.B.6
- 2. Landscape Mulch
See Subsection 702.3.07.B.2
- 3. Fertilizer
See Subsection 702.3.05.H.
- 4. Abnormal Conditions
Periodically (once every two weeks) observe trees and shrubs for abnormal conditions such as insects, borers, web worms, red spiders, etc., and immediately treat.
- 5. Sucker Growth
Remove sucker growth once a month. Sucker growth is the shoots that sprout out around the base of the tree trunk.
- 6. Pruning and Deadwood
Remove deadwood at least two times a year. Prune dead branches. Paint cuts, and wounds or scars with tree paint only when specified in the plans. Do not top Crape Myrtles. See Subsection 702.3.05.F.
- 7. Pesticide Control

Apply pesticides as necessary to control harmful insects and diseases. Follow the manufacturer's instructions. . See Subsection 702.3.07.B.4. NOTE: Use chemicals according to Federal, State and county directives on environmental control that carry an EPA approval number.

- 8. Weed Control
See Subsection 702.3.07.B
- 9. Staking and Guying
Remove all support guy wires, strapping and stakes from plants which have gone through one complete growing season.

702.4 Measurement

A. Plants

Plants of the name and size specified are measured for payment according to the number planted that are still living and viable and in an acceptable condition at the time of Final Acceptance. A viable plant must have a minimum of 75 percent of the leaf-bearing crown with healthy foliage.

B. Fertilizer

Spring application fertilizer applied to planted and regenerated areas will be the actual number of pounds (kilograms) placed and accepted. Fertilizer, lime, and plant topsoil used in prepared plant topsoil or plant bed preparation are not measured for separate payment. For stream buffer and marsh areas, the addition of fertilizer or lime is prohibited.

C. Perimeter Stakes

Perimeter stakes is not measured for payment unless such item is shown as a separate Pay Item in the Proposal.

D. Clearing and Grubbing

Clearing and grubbing is not measured for payment unless the Item is shown as a separate Pay Item in the Proposal.

E. Landscape Mulch

The quantity of landscape mulch and top-dressing measured for payment will be the actual number of square yards (meters) completed as specified and accepted. The presence of weeds or other growth, or foreign material, will be cause for rejection.

702.4.01 Limits

General Provisions 101 through 150.

702.5 Payment

A. Plants

Plants measured for payment will be paid for as follows:

1. After planting satisfactorily, the Department will pay 50 percent of the Contract Unit Price bid per each on the next estimate.
2. Until Final Acceptance, perform all required maintenance according to Subsection 702.3.07 when necessary or as ordered by the Engineer.

If the Contractor fails to properly maintain the landscaping, daily charges shall be assessed against any money due or that may become due the Contractor in accordance with the schedule of deductions shown in Subsection 108.08, but not less than \$150 per calendar day, and will continue until project maintenance is approved by the Engineer.

The charges are in addition to those specified for delay or failure in completing the Work within the specified time.

3. After the first semi-final inspection, the Department will pay 15 percent of the Contract Unit Price bid per each of the live, viable plants.
4. After the second semi-final inspection, the Department will pay 15 percent of the Contract Unit Price bid per each of the live, viable plants.
5. At Final Acceptance, the Department will pay the remaining 20 percent less the Full Contract Unit Price bid per each plant not accepted.

Payments are full compensation for furnishing, planting, replanting as required, pruning, staking, guying, soil conditioning, and preparing plant beds, including applying additives, digging plant pits, preparing plant topsoil and mulch, disposing of waste material, and maintaining the plants during the plant-establishment period.

B. Fertilizer

All grades of fertilizer applied in the spring, measured as specified above, are paid for at the Contract Price per pound (kilogram) or per ton (megagram), whichever is indicated in the Proposal. Payment is full compensation for furnishing and applying and for watering regenerated areas.

For stream buffer and marsh restoration areas, the addition of fertilizer or lime is prohibited.

C. Perimeter Stakes

Perimeter stakes will not be measured for payment. The cost will be included in the overall contract price.

D. Landscape Mulch

Landscape mulch measured for payment will be paid for as follows:

1. After mulching satisfactorily, the Department will pay 40% of the Contract Unit Price bid per square yard (meter).
2. After satisfactorily completing mulch (topdressing) in August of the first plant establishment period, the Department will pay 15% of the Contract Unit Price bid per square yard (meter).
3. After satisfactorily completing mulch (topdressing) in April of the second plant establishment period, the Department will pay 15% of the Contract Unit Price bid per square yard (meter).
4. After satisfactorily completing mulch (topdressing) in August of the second plant establishment period, the Department will pay 15% of the Contract Unit Price bid per square yard (meter).
5. After satisfactorily completing mulch (topdressing) in April of the final planting season, (a month before the Final Inspection), the Department will pay 15% of the Contract Unit Price bid per square yard (meter). Such payment shall be full compensation for furnishing, installing, topdressing, and maintaining mulch as required.
6. Do not mulch marsh restoration areas.
7. Do not apply additional applications of mulch after the initial application in stream buffer restoration areas.

Payment will be made under:

Item No. 702	Plant name and size	Per each
Item No. 702	Fertilizer, spring application	Per ton (megagram)
Item No. 702	Landscape Mulch	Per square yard (meter)
Item No. 702	Spring application fertilizer	Per pound (kilogram)
Item No. 702	Live Willow Cuttings and Planting	Per each
Item No. 702	Perimeter Stakes	Per each
Item No. 700	Agricultural Lime	Per ton (megagram)

702.5.01 Adjustments

General Provisions 101 through 150.

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA
SPECIAL PROVISION**

Section 814—Soil Base Materials

Delete 814.2.02 and substitute the following:

814.2.02 Soil-Cement Material

A. Requirements

1. Ensure that the material for soil-cement base will:
 - a. Meet the requirements of [Subsection 810.2.01](#) for Classes IA1, IA2, IA3, or IIB1 with the following modifications:

Clay content	5 to 25%
Volume change	18% maximum
Liquid Limit	25% maximum
Plasticity Index	10% maximum
Maximum dry density	95 lb/ft ³ (1520 kg/m ³) minimum
Sulfates	4000 ppm maximum
pH	4.0 minimum

- b. Be friable and not contain large amounts of heavy or plastic clay lumps, organic material, roots, or other substances that would interfere with how the Portland cement sets, plant production, or the finished surface of the base and meet the requirements of [Subsection 301.3.05.A.2, “Pulverization”](#) or [Subsection 301.3.05.B.1, “Soil”](#).
 - c. Produce a laboratory unconfined compressive strength of at least 450 psi (3.1 MPa). To make the sample, mix in a minimum of 5percent to a maximum of 9 percent Type I Portland cement, moist-cure for 7 days, and test with [GDT 65](#).
2. Analyze the soil-cement design and create a Job Mix Formula for each Project where soil-cement base or subbase is specified. Have the Job Mix Formula approved by the Engineer before starting base or subbase construction.
3. You may use fly ash or slag that meets the requirements of [Subsection 831.2.03](#) as admixtures for poorly reacting soils when the blend of soil and fly ash, or slag, meets the design requirements in this Subsection.
4. Ensure that subgrade material used underneath the soil-cement base meets the sulfate and pH requirements of this subsection (See Subsection 209.3.05.A.7).

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

Test as follows:

Test	Method
Soil gradation	GDT 4
Volume Change	GDT 6
Maximum density	GDT 7 or GDT 67
Soil-Cement Design	GDT 65
pH	GDT 98
Sulfates	ASTM D 516
Liquid Limit	AASHTO T 89
Plastic Limit and Plasticity Index	AASHTO T 90

D. Materials Warranty

General Provisions 101 through 150.

Office of Materials and Research

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA**

SPECIAL PROVISION

Section 815—Graded Aggregate

Delete Section 815 and substitute the following:

815.1 General Description

This section includes the requirements for material to be used for base, subbase, or shoulder course material, and includes graded aggregate, unconsolidated limerock base, and recycled concrete base.

815.1.01 Related References

A. Standard Specifications

[Section 800—Coarse Aggregate](#)

B. Referenced Documents

AASHTO T 11

AASHTO T 27

AASHTO T 193

ASTM C 295

ASTM D 3042

FL DOT Method FM5-515

SOP-1

QPL-2

[GDT 63](#)

EPA Method 3050/6010

EPA Method 1311

EPA Polarized Light Microscopy Method

EPA Transmission Electron Microscopy Method

815.2 Materials

815.2.01 Graded Aggregate

A. Requirements

1. Type

Use graded aggregate base, subbase, or shoulder course material of uniform quality.

- a. Obtain the graded aggregate from an approved source or deposit that will yield a satisfactory mixture meeting all requirements of this Specification.

- b. Use material that is crushed or processed as a part of the mining operations, or, mix two grades of material so that when combined in the central mix plant, the mixture meets the specifications.
2. Retained on the No. 10 (2 mm) sieve
Ensure the material retained on the No. 10 (2 mm) sieve is Class A or B aggregate that meets the requirements of [Section 800](#).
 3. Passing the No. 10 (2 mm) sieve
Ensure material passing the No. 10 (2 mm) sieve is relatively free of detrimental substances, such as soil overburden, decomposed rock, and/or swelling silts.
 4. Stabilized Mixtures
Ensure mixtures to be stabilized react satisfactorily when mixed with Portland cement. The Engineer will specify the percentage of Portland cement to use.
 5. Gradation
Grade the graded aggregate base, subbase, or shoulder material as follows:

Sieve Size	Percent Passing By Weight
Group I Aggregates	
2 in (50 mm)	100
1-1/2 in (37.5 mm)	95-100
3/4 in (19.0 mm)	60-95
No. 10 (2 mm)	25-50 (Note 1, 2 and 3)
No. 60 (250 µm)	10-35
No. 200 (75 µm)	7-15
Group II Aggregates	
2 in (50 mm)	100
1-1/2 in (37.5 mm)	95-100
3/4 in (19 mm)	60-90
No. 10 (2 mm)	25-45 (Note 2 and 4)
No. 60 (250 µm)	5-30
No. 200 (75 µm)	4-11
NOTE 1: Group I aggregates having less than 37% passing the No. 10 (2 mm) sieve, shall have at least 9 percent passing the No. 200 (75 µm) sieve.	
NOTE 2: For graded aggregate stabilized with Portland Cement, 30-50 percent by weight shall pass the No. 10 (2 mm) sieve. All other requirements remain the same.	
NOTE 3: Material passing the No. 10 (2 mm) sieve shall have a sand equivalent of at least 20 for Group I aggregates.	
NOTE 4: Material passing the No. 10 (2 mm) sieve shall have a sand equivalent of at least 28 for Group II aggregates. Sand Equivalent values as low as 20 will be acceptable provided they are attributed exclusively to rock flour and the percent passing the No. 10 (2 mm) sieve does not exceed 40.	

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

Test as follows:

Test	Method
Material that passes a No. 200 (75µm) sieve	AASHTO T 11
Gradation	AASHTO T 27
Sand Equivalent	GDT 63

D. Materials Warranty

General Provisions 101 through 150.

815.2.02 Unconsolidated Limerock Base

A. Requirements

1. Type

Use limerock base, subbase, or shoulder course material of uniform quality.

- a. To ensure uniform quality, the Department may restrict approved sources to specific mining areas, mining processes at a specific mining site, or both.
- b. Use a limerock base that yields a mixture to meet these Specifications.
- c. Use material that is crushed or processed as a part of the mining operations, or mix two grades of material so that when combined in the central mix plant the mixture meets the specifications.
- d. Use limerock base, subbase, or shoulder material that has the following characteristics:

Limerock bearing ratio	At least 100.
Deleterious substances	Do not allow chert or other extremely hard pieces that will not pass the 2 in (50 mm) sieve. Do not allow clay, sand, organics, or other materials in quantities that may damage bonding, finishing, or strength. All material passing the No. 40 (425 µm) sieve shall be non-plastic.
Carbonate content (magnesium or calcium)	At least 80%.

2. Gradation

Grade the limerock base so at least 97 percent by weight passes the 3-1/2 in (90 mm) sieve.

- a. Grade the material uniformly to dust. The fine portion passing the No. 10 (2 mm) sieve shall all be dust of fracture.
- b. Crush or break the limerock base, if necessary to meet size requirements before placing the material on the road.
- c. Ensure materials having soundness losses of 20% or less, comply with the following gradation requirements:

Gradation Requirements

Sieve Size	Percent Passing By Weight
2" (50 mm)	100
1-1/2" (37.5 mm)	95-100
3/4" (19 mm)	60-95
No. 10 (2.00 mm)	25-45
No. 60 (250 µm)	10-30
No. 200 (75 µm)	7-20

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

Test as follows:

Test	Method
Material that passes a No. 200 (75µm) sieve	AASHTO T 11
Gradation	AASHTO T 27
Limerock bearing ratio	FL DOT Method FM5-515
Petrographic analysis	ASTM C 295
Total carbonates (insoluble residue)	ASTM D 3042

D. Materials Warranty

General Provisions 101 through 150.

815.2.03 Recycled Concrete Base

A. Requirements

1. Sources

Use recycled concrete materials from sources approved by the Office of Materials and Research and listed on Qualified Products List 2. The criteria for approval will be as outlined in Standard Operating Procedure No. 1, “Monitoring the Quality of Coarse and Fine Aggregates” except the raw material will be recyclable concrete as specified herein rather than a geological deposit of aggregate.

2. Type

a. Recycled Concrete Base From Known Sources

Use recycled concrete derived exclusively from Portland cement concrete pavement or structural concrete as a base, subbase, or shoulder course.

Contaminants -

Ensure the recycled concrete is free of foreign material such as wood, steel reinforcement, clay balls, soils, epoxy expansion material, delivery unit washout material, miscellaneous paving materials, and non-construction materials.

b. Recycled Concrete Base From Unknown Sources

Use recycled concrete derived from sources of demolition materials that comply with the following requirements as a base, subbase or shoulder course. Due to the condition and type of raw material used to produce this base and the resulting difficulty in producing a consistent product, refer to SOP-1 for environmental requirements and preferred production procedures.

Ensure the finished product does not exceed the regulatory limit for asbestos of 1% (based on microscopy) and the regulatory limit for lead of 5 ppm. These determinations must be made prior to shipping.

Ensure the California Bearing Ratio (CBR) of the finished product is not less than 140.

Contaminants –

Ensure the recycled concrete is substantially free of foreign materials such as steel reinforcement, wood, clay balls, soils, epoxy expansion material and non-construction materials.

Note - Substantially free, in the context of this specification, shall mean concentrations of the above mentioned foreign materials individually shall not exceed 0.1percent by weight, nor shall the total concentration of these materials exceed 0.5 percent by weight.

Keep the following ancillary materials within these limits:

Substance	Maximum Percent by Weight
Brick	3
Asphaltic Concrete	7
Weathered Rock	2
Any combination of Brick, Asphaltic Concrete or Weathered Rock	10

3. Gradation

Ensure the finished product meets the quality and gradation requirements of Subsection 815.2.01 for Group II aggregates, except the material finer than a #200 (75µm) sieve shall be 2 – 11%.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

Test as follows:

Test	Method
Gradation	AASHTO T 27
Material that passes a #200 (75µm) sieve	AASHTO T 11
Sand Equivalent	<u>GDT 63</u>
California Bearing Ratio (CBR)	AASHTO T 193
Petrographic Analysis	ASTM C 295
Total Lead	EPA Method 3050/6010
Toxicity Characteristic Leaching Procedure	EPA Method 1311
Asbestos	EPA Polarized Light Microscopy Method <u>Or</u> EPA Transmission Electron Microscopy Method

D. Materials Warranty

General Provisions 101 through 150.

Office of Materials and Research

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA**

SPECIAL PROVISION

Section 820—Asphalt Cement

Delete Section 820 and substitute the following:

820.1 General Description

This section includes the requirements for asphalt cements prepared from crude petroleum.

820.1.01 Related References

A. Standard Specifications

General Provisions 101 through 150.

B. Referenced Documents

Standard Operating Procedure (SOP 4)

AASHTO R 28

AASHTO T 48

AASHTO T 179

AASHTO T 240

AASHTO T 313

AASHTO T 314

AASHTO T 315

AASHTO T 316

AASHTO TP70 (proposed) / ASTM D7405

820.2 Materials

820.2.01 Asphalt Cement

A. Requirements

1. Type

Use a material homogenous and water-free and will not foam when heated to 347 °F (175 °C).

Ensure that a blend used to produce a specified performance grade meets the following requirements:

- Is uniform and homogeneous without separation
- Uses PG 64-22 or PG 67-22 described below for the base asphalt
- Consists of production materials not being “air-blown or acid modified” to achieve the performance grade

2. Grade

Use the various grades of asphalt cement meeting the requirements shown in the test requirements for Petroleum Asphalt Cements

Add only Styrene-Butadiene-Styrene (SBS) or Styrene-Butadiene (SB) to neat asphalt to produce a binder meeting requirements for PG 76-22.

For non Stone Matrix Asphalt Mixtures (SMA) and porous (PEM or OGFC) mixes, SBR or Crumb rubber modified PG 76-22 is an acceptable alternative to SBS or SB modified asphalt cement at contractor's discretion, provided the SBR or crumb rubber modified asphalt cement meets the tests' requirements of PG 76-22. For SBR modified PG 67-22 to meet PG 76-22, use only SBR currently approved on QPL-65 "Georgia's List of Approved Latex Suppliers". For crumb rubber modified PG 67-22 to meet PG 76-22, use 30 mesh size ambient or cryogenic ground tire rubber at minimum 10% of weight of total asphalt cement content. Percentage of ambient or cryogenic ground tire rubber is neat asphalt source dependent to meet specification requirements for PG76-22. Ensure Trans-Polyoctenamer be added at 4.5% of the weight of the crumb rubber to achieve better particle distribution. The maximum Phase Angle requirement is not applicable to the crumb rubber modified PG 76-22 (see notes f and g).

Test Requirements for Petroleum Asphalt Cements

Test And Method	Test Temperature				Original Binder	Residue Of Binder After:	
	PG 58-22 (Note e)	PG 64-22	PG 67-22	PG 76-22 (Note d)		Rolling Thin Film Oven, AASHTO:T 240	Pressure Aging AASHTO: R 28
Flash Point, Min., AASHTO T 48					446 °F (230 °C)		
Viscosity, Max., AASHTO T 316, (Note a)	275 °F (135 °C)				3Pa-S (3000CP)		
Mass Loss (%), Max., AASHTO T 240, (Note b)						0.5	
Dynamic Shear, G*/sin δ, AASHTO T 315, 10 Rad/Sec	136 °F (58 °C)	147 °F (64 °C)	153 °F (67 °C)	169 °F (76 °C)	≥ 1.0 kPa	≥ 2.2 kPa	
Dissipated Energy, Dynamic Shear, G* sin δ, AASHTO T 315, 10 Rad/Sec	72 °F (22 °C)	77 °F (25 °C)	80 °F (26.5 °C)	88 °F (31 °C)			≤ 5000 kPa
Creep Stiffness, 60 sec., AASHTO T 313, (Note c)	10 ° F (- 12 °C)						S ≤ 300 000 kPa m ≥ 0.300
Direct Tension, 1.0 mm/min., AASHTO T314, Failure Strain	10 ° F (- 12 °C)						Report
Multiple Stress Creep & Recovery (MSCR) test, ASTM D7405, AASHTO TP70 (proposed), J _{nr 3.2} kPa, (Note f)(Note g)				64 °C		≤ 1.0	

Notes:

- The Department may waive this requirement if the supplier warrants the asphalt binder can be adequately pumped and mixed at temperatures meeting all applicable safety standards.
- Heat loss by AASHTO: T 179 may be accepted in lieu of mass loss by AASHTO: T 240.
- If the creep stiffness is below 300 000 kPa, the direct tension test is not required. If the creep stiffness is ≥300 000 kPa, report the Direct Tension Failure Strain value. Satisfy the m-value requirement in either case.
- The maximum Phase Angle measured by DSR shall be ≤ 75 degrees.
- The maximum Mass Loss shall be ≤ 1%, when used in conjunction with Bituminous Surface Treatment (Section 424).
- MSCR requirement is applicable to the SBR, Crumb Rubber & TOR combination modified PG PG76-22 asphalt cement. Additionally, they shall meet all PG 76-22 requirements except for phase angle.
- Percent recovery at 3.2 kPa shall be ≥ 35%.

Thoroughly blend the composite materials at the supply facility prior to being loaded into the transport

vehicle if modification is required. Ensure all blending procedures, formulation, and operations are approved by the Office of Materials and Research.

3. Certification:

Provide certified test results from an approved, certified laboratory of blends for proposed PG asphalt for each specification characteristic of the asphalt cement proposed for shipment. Provide the certified results to the State Materials and Research Engineer as required in Standard Operating Procedure (SOP 4).

The State Materials and Research Engineer may interrupt production until test results are known in the event there is reason to suspect a sample will be outside specification limits.

B. Materials Warranty

General Provisions 101 through 150.

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA**

SPECIAL PROVISION

Section 822 — Emulsified Asphalt

Delete Section 822 and substitute the following:

822.1 General Description

This section includes the requirements for homogenous emulsions of asphalt, water, and emulsifying agents.

822.1.01 Related References

A. Standard Specifications

[Section 820–Asphalt Cement](#)

B. Referenced Documents

AASHTO T 50

AASHTO T 59

822.2 Materials

822.2.01 Emulsified Asphalt

A. Requirements

1. Type

Use materials not containing lumps and not showing separation during handling or storage of up to 30 days.

2. Grade

Use the various grades of emulsified asphalts meeting or exceeding the requirements in [Table 1](#).

Table 1—Requirements for Emulsified Asphalt

Type	Rapid Setting		Slow Setting				Prime			
	RS-2h Min. Max.		SS-1h Min. Max.	SS-1 Min. Max.	NTSS-1HM Min. Max.		EAP-1 Min. Max.			
Tests on Emulsion: Viscosity Saybolt Furol at 77 °F (25 °C), (Sec.)			20	100	20	100	20	100	15	100
Viscosity Saybolt Furol at 122 °F (50 °C), (Sec.)	75	400								
(a).Settlement 5 Days, (Percent)		5		5		5				5
(b).Storage Stability Test 1 Day, (Percent)		1		1		1				1
(c).Demulsibility, 35 ml, 0.02N. CaCl ₂ , (Percent)	60									
(d).Cement Mixing Test, (Percent)				2.0		2.0				

Sieve Test, (Percent)	0.10	0.10	0.10	0.30	0.10
Oil Distillate by Volume (Percent)				1 5	12
Residue by Distillation (Percent AC)	63	57	57	50	50
Tests on Residue from Distillation Test: Penetration 77 °F (25 °C) 100 gm/5 Sec. (dmm)	80 140	40 110	100 200	20	
Ductility at 77 °F (25 °C) 5 cm/min. (cm)	40	40	40		
Solubility in Trichloroethylene, (Percent)	97.5	97.5	97.5	97.5	97.5
Float at 140 °F (60 °C), (Sec.)					20
Softening Point, °C				65	
Original DSR @ 86°C G*/Sinδ, 10 rad/s, kPa				1.0	

- (a) The test requirement for settlement may be waived when the emulsified asphalt is used in less than five (5) days; or the Engineer may require that the settlement test be run from the time the sample is received until it is used, if the elapsed time is less than five (5) days, if there is an issue of quality.
- (b) The 24-hour (1 day) storage stability test may be used but does not predict that the 5 day settlement test will pass.
- (c) Ensure the demulsibility test is made within 30 days from date of shipment.
- (d) Ensure the cement mixing test will be applicable only if material is used in Asphalt Slurry Seal.
- (e) Anionic emulsified asphalt is not compatible with cationic emulsions (CRS, CMS, CSS, CQS etc.). Ensure all equipment is thoroughly cleaned if cationic emulsion was previously present.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

Test as follows:

Test	Method
Testing emulsified asphalts	AASHTO T 59
Float test	AASHTO T 50

D. Materials Warranty

General Provisions 101 through 150.

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA**

SPECIAL PROVISION

Section 824 — Cationic Asphalt Emulsion

Delete Subsection 824.1.01.B and substitute the following:

B. Referenced Documents

AASHTO T 49
AASHTO T 51
AASHTO T 53
AASHTO T 59
AASHTO T 72
AASHTO T 301
AASHTO T 302
ASTM D 5546 - 01
[QPL 65](#)
[GDT 44](#)
[GDT 91](#)
[GDT 135](#)

Add the following:

824.2.02 Latex-Modified Cationic Asphalt Emulsion

A. Requirements

1. Latex Rubber Additive (LRA)
 - a. Ensure the LRA is a natural latex or an unvulcanized styrene-butadiene rubber in an emulsified latex form.
 - b. Ensure that the LRA comes from an approved source listed in the Department's current [QPL 65](#) for use in cationic asphalt emulsion.
2. Latex-Modified Cationic Asphalt Emulsion
 - a. Use PG58-22 as the base asphalt.
 - b. Add the LRA in the necessary proportions to result in a minimum of 3% polymer by weight of the asphalt residue.
 - c. Co-mill the LRA and asphalt cement while manufacturing the emulsified asphalt to produce a homogeneous mixture.
 - d. Ensure the latex-modified cationic asphalt emulsion, when undisturbed for 24 hours, shows no separation of emulsion and LRA and no color striations, but has a uniform color throughout.
 - e. Use a latex-modified cationic asphalt emulsion that meets the requirements in Table 2.

Table 2 – Requirements for Latex-Modified Cationic Asphalt Emulsion

Type Tests	Rapid Setting	
	CRS-2L	
Tests on Emulsion	Min	Max
Viscosity, Saybolt Furol @ 122 °F (50 °C), sec.	100	400
Storage stability, 24 hours, percent		1
Settlement, 5 days, percent		5
Demulsibility, 35 ml, 0.8% dioctyl sodium sulfosuccinate, percent	40	
Particle charge test	Positive	
Sieve test, percent		0.10
Residue by distillation, percent ¹	65	
Tests on Emulsion Residue	Min	Max
Penetration @ 77 °F (25 °C), 100g, 5 sec., (dmm)	70	150
Ductility, @ 77 °F (25 °C), 5 cm/min., (cm)	100	
Elastic recovery @ 50°F (10 °C), percent ²	55	
Ring & ball softening point, °F	125	
Solubility in toluene by centrifuge, percent	97.5	
Polymer solids content, percent	3.0	
1. AASHTO T-59 modified to include a maximum temperature of 400°F ± 10°F (204°C ± 5°C) to be held for a period of 15 minutes. 2. GDT-135, Residue by evaporation.		

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

Test as follows:

Test	Method
Penetration of bituminous materials	AASHTO T 49
Ductility	AASHTO T 51
Softening point of bitumen	AASHTO T 53
Testing emulsified asphalts	AASHTO T 59
Viscosity	AASHTO T 72
Elastic recovery	AASHTO T 301
Polymer content of polymer-modified emulsions	AASHTO T 302
Solubility of asphalt binders in toluene by centrifuge	ASTM D 5546 – 01
Residue by evaporation of latex-modified asphalt emulsions	GDT-135

D. Materials Warranty

General Provisions 101 through 150.

Office of Materials and Research

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA**

SUPPLEMENTAL SPECIFICATION

Section 831—Admixtures

Delete Subsection 831.2.01.A and substitute the following:

831.2.01 Air-Entraining Admixtures

A. Requirements

1. Use air-entraining admixtures listed in [QPL 13](#).
2. Use air-entraining admixture materials meeting AASHTO M 154, Performance and Uniformity requirements.
3. Test compression and flexure strengths at 7 and 28 days.
4. Use air-entraining admixtures evaluated by the National Transportation Product Evaluation Program (NTPEP) test facility or other approved test facility.

Delete Subsection 831.2.02.A and substitute the following:

831.2.02 Chemical Admixtures for Concrete

A. Requirements

1. Use chemical admixtures listed in [QPL 14](#).
2. Use chemical admixture materials meeting AASHTO M 194 Physical requirements and Uniformity and Equivalence requirements for Types A, B, C, D, E, F, or G, unless otherwise specified.
 - a. Waive the length change requirements.
 - b. Ensure that the admixtures contain no more than 0.8 percent chloride, calculated as calcium chloride.
 - c. Ensure that the air content does not exceed 4 percent when prepared in a standard batch without an added air-entraining agent.
3. Use chemical admixtures evaluated by the National Transportation Product Evaluation Program (NTPEP) test facility or other approved test facility.

Office of Materials and Research

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA**

SUPPLEMENTAL SPECIFICATION

Section 832—Curing Agents

Delete Subsection 832.2.01.A and substitute the following:

832.2.01 Burlap or Cotton Fabric

A. Requirements

1. Use burlap or cotton fabric meeting these requirements:
 - Burlap that is 10 to 18 oz./yd² (340 to 610 g/m²) or two layers of 6 or 7 oz./yd² (200 or 235 g/m²)
 - Cotton fabric that is white, loosely woven, and not less than 7 oz./yd² (235 g/m²)
 - Strips of burlap or cotton fabric that are between 3 and 6 ft (0.9 and 1.8 m) wide and 3 ft (1 m) longer than the width of the slab to be covered
2. Use burlap and cotton fabrics that do not contain starch or other material that could stain the concrete. If the fabric is new, soak and dry it before use.

Delete Subsection 832.2.03.A and substitute the following:

832.2.03 Membrane Curing Compound

A. Requirements

1. Use membrane curing compounds listed in [QPL 16](#)
2. Use liquid membrane-forming compounds meeting AASHTO M 148 requirements.
3. Use membrane curing compounds evaluated by the National Transportation Product Evaluation Program (NTPEP) test facility or other approved test facility.

Office of Materials and Research

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA
SUPPLEMENTAL SPECIFICATION**

Section 833—Joint Fillers and Sealers

Delete Subsection 833.2.06 and substitute the following:

A. Requirements

1. Silicone

Furnish silicone sealant in a one-part or two part silicone formulation. Use sealant that is compatible with the surface to which it is applied. Do not use acid-cure sealants on Portland cement concrete.

- a. Use silicone that meets the physical requirements in [Table 1](#). For a list of silicone joint sealant sources, please see [QPL 66](#). Identify silicones as the following types:
 - 1) Type A—A one part, low modulus, non-sag silicone. Used to seal horizontal and vertical joints in Portland cement concrete pavements and bridges. Tooling is required.
 - 2) Type B—A one part, very low modulus, self-leveling silicone. Used to seal horizontal joints in Portland cement concrete pavements and bridges. Tooling is not normally required.
 - 3) Type C—A one part, ultra-low modulus, self-leveling silicone. Used to seal horizontal joints in Portland cement concrete pavements and bridges and joints between Portland cement concrete pavement and asphaltic concrete shoulders. Tooling is not normally required.
 - 4) Type D—A two part, ultra low modulus, self-leveling, rapid cure silicone. Used to seal horizontal joints in Portland cement concrete pavements and bridges and joints between Portland cement concrete pavement and asphaltic concrete shoulders. Tooling is not required.
- b. Use silicone sealant evaluated by the National Transportation Product Evaluation Program (NTPEP).
- c. Use sealant that is compatible with the surface to which it is applied. Do not use acid-cure sealants on Portland cement concrete.
- d. Use silicone that meets the following physical requirements:

Table 1—Physical Requirements for Silicone Sealants

Type Silicone	A	B	C	D
Tensile Stress at 150% Strain, Max. psi (kPa) (Note 1)	45 (310)	40 (275)	15 (105)	25 (175)
Durometer Hardness, Score [0 °F and 77 °F ± 3 °F (-18 °C and 25 °C ± 2 °C)] (Note 1)	“A” 10-25	“00” 40-80	“00” 20-80	“00” 40-80
Bond to Concrete Mortar, Min. psi (kPa) (Note 1) (Note 3)	50 (345)	40 (275)	35 (240)	35 (240)
Tack Free Time (Skin-over) (Max. Minutes) (Note 2)	90	90	90	30
Extrusion Rate (Min. Grams/Minute) (Note 4)	75	90	100	200-550
Non-volatile (Min. %)	90	90	90	90
Specific Gravity	1.1 - 1.5	1.1 - 1.5	1.1 - 1.5	1.2 - 1.5
Shelf Life (from date of shipment)	6 Months	6 Months	6 Months	6 Months
Movement Capability & Adhesion (Note 1)	No adhesive or cohesive failure after 10 cycles at 0 °F (-18 °C).			

Section 833-Joint Fillers and Sealers

Type Silicone	A	B	C	D
Ozone and U.V. Resistance (Note 1)	No chalking, cracking or bond loss after 5,000 hours.			
Note 1: The cure time for these specimens shall be 21 days for Type A and 28 days for Type B, C and D. Specimens shall be cured at 77 °F ± 3 °F (25 °C ± 2 °C) and 50±5% relative humidity.				
Note 2: At conditions of 77 °F ± 3 °F (25 °C ± 2 °C) and 50±5% relative humidity.				
Note 3: Type C and D silicone shall also meet its bond strength requirement to asphalt concrete.				
Note 4: Type D extrusion rate shall be within the range specified.				

2. Bond Breakers

Bond breakers shall be chemically inert and resistant to oils, gasoline, solvents, and primer, if one is required. Install silicone sealants over a bond breaker to prevent the sealant from bonding to the bottom of the joint.

- a. Use bond breakers that are chemically inert and resistant to oils, gasoline, solvents, and primer, if one is required.
- b. Do not use bond breaker that will stain or adhere to the sealant.
- c. Use either a backer rod or tape bond breaker.

1) Backer Rods

Type L	Closed-cell, expanded polyethylene foam
Type M	Closed-cell, polyolefin foam with a closed-cell skin over an open-cell core

Use backer rods that meet the following physical requirements:

Physical Property	Requirement
Density	2 lb/ft ³ (30 kg/m ³)min.
Tensile strength	25 psi (170 kPa) min.
Water absorption	0.02 g/cm ³ max.

2) Bond Breaking Tapes

Type N bond breaking tapes are made from extruded polyethylene with a pressure-sensitive adhesive on one side.

Bond breaking tapes may be used with all three types of silicone, but is suitable for bridge joints only.

Bond breaking tapes shall have a minimum thickness of .005 in (0.13 mm.).

3. Joint Sealant Certification

Submit, at no cost to the Department, a minimum of 30 gal (100 L) of material and certified test results on each lot of joint sealant furnished to a Project.

Submit a certification that verifies the sealant meets all the test requirements of this Specification, except the Bond to Concrete Mortar and Shore Durometer Hardness at 0 °F (-18 °C).

B. Fabrication

Prepare and install silicone and bond breakers according to [Section 461](#).

C. Acceptance

1. Silicone

Test the silicone as follows:

Test	Method
Tensile stress	ASTM D 412 (die C)
Durometer hardness	ASTM D 2240
Bond to concrete mortar	GDT 106

Section 833-Joint Fillers and Sealers

Test	Method
Tack free time (skin-over)	GDT 106*
Extrusion rate	GDT 106
Non-volatile	GDT 106
Specific gravity	ASTM D 792 (Method A)
Movement capability and adhesion	GDT 106
Ozone and UV resistance	ASTM C 793
*In cases of dispute, use ASTM C 679 as a referee test.	

2. Bond Breakers

Test the bond breaker backer rods as follows:

Test	Method
Density	ASTM D 1622
Tensile strength	ASTM D 1623
Water absorption	ASTM C 1016

3. Department Responsibility

The Department will:

- a. Evaluate the sealant in the field before accepting any silicone sealants that meet the requirements of this Specification.
- b. Install the material submitted by the Contractor in roadway and/or bridge joints. The material shall be in place for two winters without failure before being accepted.
- c. Reject any sealant or bond breaker that is evaluated and approved, yet fails in actual use.

D. Materials Warranty

General Provisions 101 through 150.

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA**

SUPPLEMENTAL SPECIFICATION

Section 845—Smooth Lined Corrugated Polyethylene (PE) Culvert Pipe

Delete Section 845 and substitute the following:

845.1 General Description

This section includes the requirements for smooth-lined, corrugated polyethylene culvert pipe.

845.1.01 Related References

A. Standard Specifications

General Provisions 101 through 150.

B. Referenced Documents

AASHTO M 294

AASHTO Standard Specifications for Highway Bridges, Division II

[QPL 51](#)

845.2 Materials

845.2.01 Smooth-lined, Corrugated Polyethylene (PE) Culvert Pipe

A. Requirements

1. Use pipe meeting the requirements of AASHTO M 294, Type S.
2. Use pipe evaluated by the National Transportation Product Evaluation Program (NTPEP) test facility or other approved test facility.
3. Ensure pipe is produced from an approved source listed on [QPL 51](#).
4. Use fittings and couplings as recommended by the manufacturer and approved by the Office of Materials and Research. The fittings and couplings shall comply with the joint performance criteria of AASHTO Standard Specifications for Highway Bridges, Division II. Ensure that the joints are “soiltight” per the AASHTO bridge specifications.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

General Provisions 101 through 150.

D. Materials Warranty

General Provisions 101 through 150.

Office of Materials and Research

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA**

Supplemental Specification

Section 853—Reinforcement and Tensioning Steel

Delete Section 853 and Substitute the following:

853.1 General Description

This section includes the requirements for reinforcement and tensioning steel, including:

- Steel bars
- Pretensioning steel wire strand
- Post-tensioning steel wire
- Post-tensioning steel bars
- Plain steel bars with threaded ends
- Steel wire
- Steel welded wire reinforcement
- Dowel bars
- Dowel (tie) bars
- Bar supports
- Epoxy coating

853.1.01 Related References

A. Standard Specifications

[Section 514—Epoxy Coated Steel Reinforcement](#)

B. Referenced Documents

AASHTO	ASTM	
M 32/ M 32M	A 153/ A 153 M	A 653/ A653M
M 55/ M 55M	A 416/ A 416M	A 709/ A 709M
M 221/ M 221M	A 421/ A 421M	A 722/ A 722M
M 225/ M 225M		D 1248
M 284/ M 284M		

[QPL 12](#)

[QPL 55](#)

[QPL 61](#)

CRSI Manual of Standard Practices

853.2 Materials

A. Requirements

NOTE: Notify the Office of Materials and Research at least two weeks before blast cleaning the steel reinforcement bars and applying the epoxy coating. This time will allow the Department to schedule an inspection.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

General Provisions 101 through 150.

853.2.01 Steel Bars for Concrete Reinforcement

A. Requirements

1. Type

- a. Use deformed billet steel bars from rolling mills listed on [QPL 61](#) and from fabricators listed on [QPL 12](#)
- b. Use deformed billet steel bars that meet the requirements of ASTM A 615/ A 615M for bar reinforcement in concrete, unless otherwise designated.
- c. Use deformed billet steel for longitudinal bars in continuously reinforced concrete pavement that meet the requirements of ASTM A 615/ A 615M, Grade 60 (420).

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

The Department will accept the material based on either [QPL](#) approval or on tests conducted by the Department.

The Department will not accept bent bars that have been straightened and rebent.

D. Materials Warranty

General Provisions 101 through 150.

853.2.02 Pretensioning Steel Wire Strand

A. Requirements

1. Type

Use steel wire that meets all the requirements of ASTM A 416/A 416M. Use Grade 270 for prestressed concrete bridge members.

- a. If you plan to use strands that differ in size from those covered in ASTM A 416/A 416M submit to the Engineer complete data on the proposed strands, as stated below.

2. Certification

Submit a certification from the manufacturer that shows the results of the required tests, including stress-strain curves, and conformance to these Specifications.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

The Department will accept the steel based on the results of tests made by the Department and the certification from the manufacturer.

D. Materials Warranty

General Provisions 101 through 150.

Section 853—Reinforcement and Tensioning Steel

853.2.03 Post-tensioning Steel Wire

A. Requirements

1. Type
Use steel cable for post-tensioning that meets ASTM A 421/ A 421M, Type BA or WA, as specified.
2. Certification
Submit a certification from the manufacturer that shows the results of the required tests, including stress-strain curves, and conformance to these Specifications.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

The Department will accept the steel based on the results of tests made by the Department and the certification from the manufacturer.

D. Materials Warranty

General Provisions 101 through 150.

853.2.04 Post-tensioning Steel Bars

A. Requirements

1. Type
Use high-strength steel bars for post-tensioning that meet the requirements of ASTM A 722/ A 722M, Type II.
2. Drawings
 - a. Show all appurtenances to be used with the bars on shop drawings.
 - b. Show all dimensions and steel requirements on the drawings.
 - c. Use the appropriate ASTM designation for the steel, if possible.
3. Certification
Submit a certification that shows the results of the required tests, including stress-strain curves, and conformance to this Specification.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

The Department will accept the steel based on the results of the tests made by the Department and on the certification from the manufacturer.

D. Materials Warranty

General Provisions 101 through 150.

853.2.05 Plain Steel Bars—Threaded Ends

A. Requirements

Use plain steel bars with threaded ends that meet the requirements of ASTM A 709/ A 709M, Grade 36 (250), 50(345), or 70W(485W).

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

The Department will accept the steel based on the certification from the manufacturer.

D. Materials Warranty

General Provisions 101 through 150.

Section 853—Reinforcement and Tensioning Steel

853.2.06 Steel Wire for Concrete Reinforcement

A. Requirements

Use steel wire that meets the requirements of AASHTO M 32/ M 32M and AASHTO M 225/ M 225M and is the size shown on the Plans.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

The Department will accept the steel based on the results of the tests made by the Department or on the certification from the manufacturer.

D. Materials Warranty

General Provisions 101 through 150.

853.2.07 Steel Welded Wire Reinforcement

A. Requirements

1. Use steel welded wire reinforcement of the size and dimension shown on the Plans and that meets the requirements of AASHTO M 55/ M 55M and AASHTO M 221/ M 221M.
2. Use a vendor listed on [QPL 55](#).

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

The Department will accept the material based on either [QPL](#) approval or on tests conducted by the Department.

D. Materials Warranty

General Provisions 101 through 150.

853.2.08 Dowel Bars

A. Requirements

Type: Use dowel bars for concrete pavement that are plain, round steel bars that meet or exceed the tensile requirements of Table 2—Tensile Requirements for Deformed Bars, ASTM A 615/ A 615M, Grade 40 (300).

B. Fabrication

Coat dowel bars with either high density polyethylene or epoxy, as follows:

1. High Density Polyethylene

Use polyethylene with the following characteristics

Thickness	12 to 20 mils (0.30 to 0.51 mm)
Texture	Smooth and dense enough to provide adequate bond-breaking characteristics
Undercoating (adhesive)	Modified rubber blend; 2 to 7 mils (0.05 to 0.18 mm) thick

Ensure that the undercoating retains its elasticity and effectively seals small cuts or abrasions from moisture migrating under the polyethylene plastic outer coating.

2. Epoxy

Prepare the dowels for coating, select the epoxy material, apply the epoxy, and sample and test the properties of coated bars according to the requirements of [Section 514](#).

- a. Apply a uniform, smooth coating to the bars that results in a film 12 mils, \pm 2 mils (0.30mm, \pm 0.05 mm) thick after curing.
- b. Do not coat the cut ends.

Section 853—Reinforcement and Tensioning Steel

- c. Handle the coated dowels carefully to prevent damage to the coating or bar. However, bars can be welded through the epoxy to one side of the supportive basket.

C. Acceptance

The Department will accept the steel based on the results of the tests made by the Department or on the certification of the manufacturer.

The Department will reject dowel bars with burred or deformed ends.

D. Materials Warranty

General Provisions 101 through 150.

853.2.09 Dowel (Tie) Bars

A. Requirements

Use uncoated, plain or deformed billet-steel bars that meet the requirements of ASTM A 615/ M, Grade 40 (300) for dowel bars or tie bars in curbs, concrete medians, and other areas specified on the Plans.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

The Department will accept the steel based on the results of the tests made by the Department or on the certification of the manufacturer.

D. Materials Warranty

General Provisions 101 through 150.

Office of Materials and Research

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA**

SUPPLEMENTAL SPECIFICATION

Section 863—Preservative Treatment of Timber Products

Delete Section 863 and Substitute the following:

863.1 General Description

This section includes the requirements for applying preservatives, conditioning, treating, inspecting, marking, testing, and documenting the necessary information for treated timber used in Department Work.

863.1.01 Related References

A. Standard Specifications

General Provisions 101 through 150.

B. Referenced Documents

American Wood Preservers Association (AWPA), C14, “Wood for Highway Construction— Preservative Treatment by Pressure Method”

AWPA C2

AWPA M2

AWPA M3

AWPA P9

AASHTO M 133

[QPL 50](#)

863.2 Materials

863.2.01 Conditioning and Preservative Treatment

A. Requirements

1. Condition and preservative treat all timber products to meet the requirements of American Wood Preservers Association (AWPA) Standard C14, “Wood for Highway Construction—Preservative Treatment by Pressure Method,” except as described in this Section.
2. Treatment Plants

Ensure treatment plants comply with quality control procedures in AWPA M3.

 - a. To expedite the work, a commercial inspection agency approved by the Department will inspect and test all treated timber products, including any preservative treatment at the treatment plant before it is delivered to the project. The treatment plant shall bear all the cost associated with the inspection and test.
 - b. Before requesting an inspection, the authorities of the treatment plant shall acquaint themselves with the timber specification requirements and shall segregate the material to be inspected for Department work from other stock.
3. Preservatives

Use preservatives that meet the requirements in the AWPA Standard, unless otherwise specified in the Plans or the Specifications.

 - a. You may select one of three preservatives (creosote, pentachlorophenol, Chromated Copper Arsenate (CCA)) from the Materials and Usage Table in AWPA C14.

- b. Ensure pentachlorophenol solutions have at least 5 percent pentachlorophenol, by weight, dissolved in the petroleum solvents specified or pentachlorophenol in AWPA P9, Type “A.”

B. Fabrication

- 1. As practicable, cut, frame, and bore timber before treatment.
- 2. Condition the timber first. For Southern Pine species, use the following treatment:

Penta-petroleum	Dry in kiln to 30% average moisture content or less or condition in steam
Chromated Copper Arsenate (CCA)	Dry in kiln to 25% average moisture content or less

NOTE: Do not heat the wood in the preservative, and do not use Boulton drying.

- 3. Preservative Penetration

Ensure the preservative penetrates at least 3 in (75 mm) or 90 percent of the sapwood for all lumber, timber, wood fence posts, and ties in contact with the ground.

 - a. Ensure lumber, timber, and ties that do not contact the ground meet AWPA C2 requirements.
 - b. Ensure preservative penetrates all other materials, piles, and poles according to applicable AWPA requirements.
- 4. Preservative Retention

Treat guard rail posts and offset blocks with pentachlorophenol or CCA with a minimum 0.6 lb/ft³ (9.6 kg/ m³) retained in the outer 0.6 in (15 mm), as required in AWPA C14 and C2.
- 5. Retreatment:

You may retreat a charge of material, or a portion of it, if the initial treatment does not meet requirements for retention, penetration, or appearance. The Department will allow only one retreatment.

NOTE: The Department will reject any damage due to retreatment.

- 6. Conditioning after Treatment
 - a. Condition material that is dust-free.
 - b. For lumber or timber that is treated with water-borne preservative and is to be painted, dry by air, kiln, or some method of artificial conditioning, to a moisture content of not more than 19 percent of the weight of the oven-dry wood.
 - c. Protect the treated lumber from the elements with a prime coat of paint or other approved means.
 - d. Ensure the moisture content does not rise above 19 percent before applying the first coat of paint.
 - e. Dry material treated with water-borne preservative that will not be painted to surface dryness in air or otherwise before installing it.

C. Acceptance

- 1. Inspection

The Department will sample and test preservatives according to the requirements of AASHTO M 133.

NOTE: Check [QPL 50](#) for pre-approved manufacturers that supply material compliant with this specification.

- a. The Department will determine the level of preservative retention by testing the 0.6 to 1.5 in (15 to 38 mm) assay zone.
- b. Unless otherwise provided, an approved commercial inspection agency will inspect treated timber products according to AWPA M2.
- c. The Inspector will test before, during, and after treating.
- 2. Marking

The Inspector will mark each acceptable piece with a hammer stamp before and after treatment.

 - a. Stamp only 25 percent of the offset blocks after treatment.
 - b. Ensure that both inspection stamps identify the Inspector. Ensure that the before-treatment stamp is clearly distinguished from the after-treatment stamp.

3. Reporting

The Inspector from an approved commercial inspection agency shall:

- a. Prepare reports of the treating process and results of the inspection that confirm treatment was completed according to these Specifications.
- b. Furnish these reports to the Office of Materials and Research.
- c. Report according to AWPA M2.
- d. Get a shipping report from the treatment plant showing the project number, purchaser, sizes and amounts of materials, and preservative type for each shipment for Department Work.
- e. Furnish the shipment report and the treatment report to the Office of Materials and Research.

D. Materials Warranty

1. Retest treated material that has been in stock for two years before using.
2. The Department will reject any materials that fail to meet specifications unless they are retreated to meet all applicable requirements.

Office of Materials and Research

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA
SPECIAL PROVISION**

Section 881—Fabrics

Delete Section 881 and substitute the following:

881.1 General Description

This section includes the requirements for the following fabrics:

- Plain cotton duck
- Rubber-impregnated cotton duck
- Burlap and cotton bags
- Plastic filter fabric
- Pavement reinforcement fabric
- Silt fence filter fabric

881.1.01 Related References

A. Standard Specifications

[Section 106—Materials Certification](#)

B. Referenced Documents

Federal Specification CCC-C 419 Type III

ASTM D 36

ASTM D 146

ASTM D 412

ASTM D 1777

ASTM D 3786

ASTM D 4355

ASTM D 4632, GRAB

ASTM D 4751

ASTM D 4833

[GDT 87](#)

[GDT 88](#)

[GDT 95](#)

[QPL 28](#)

[QPL 36](#)

[QPL 40](#)

[QPL 47](#)

881.2 Materials

881.2.01 Plain Cotton Duck

A. Requirements

1. Use plain cotton duck meeting the requirements of Federal Specification CCC-C 419 Type III.
2. Ensure the duck weighs at least 8 oz./yd² (270 g/m²).

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

General Provisions 101 through 150.

D. Materials Warranty

General Provisions 101 through 150.

881.2.02 Rubber-Impregnated Cotton Duck

A. Requirements

1. Use preformed rubber-impregnated fabric pads made of multiple layers of 8 oz (270 g) cotton duck, impregnated and bound with high quality natural rubber, or made of equivalent materials compressed into resilient pads of uniform thickness.
2. Use enough plies to reach the specified thickness after compression and vulcanizing.
3. Ensure the finished pad withstands compression loads of not less than 10,000 psi (70 MPa) when applied perpendicular to the plane of the laminations. Ensure the pad does not extrude or harmfully reduce in thickness.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

General Provisions 101 through 150.

D. Materials Warranty

General Provisions 101 through 150.

881.2.03 Burlap Bags

A. Requirements

Use burlap bags made of at least 95 percent jute and manila fibers.

Use burlap weighing 8 to 18 oz/10 ft² (250 to 550 g/m²).

Use bags with a capacity of 1 to 2 ft³ (0.03 to 0.06 m³).

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

General Provisions 101 through 150.

D. Materials Warranty

General Provisions 101 through 150.

881.2.04 Cotton Bags

A. Requirements

1. Use cotton bags with Osnaburg 40 x 26 thread count and a nominal fabric weight of 6.8 oz/yd² (230 g/m²).
2. Use bags having 1/2 in (13 mm) sewn seams with at least 1 stitch per 1/5 in (5 mm).
3. Use 4 or 5 ply, 12 cotton yarn or equivalent for the stitches.
4. Ensure seam efficiency is at least 80 percent. Ensure the inside measurements tolerance is ± 1/2 in (13 mm).

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

General Provisions 101 through 150.

D. Materials Warranty

General Provisions 101 through 150.

881.2.05 Plastic Filter Fabric

A. Requirements

1. Use pervious sheets of plastic yarn made from a long-chain synthetic polymer. Use polymer composes of at least 85 percent by weight of propylene, ethylene, amide, ester, or vinylidene chloride.
Use a sheet of plastic yarn containing stabilizers and/or inhibitors added to the base plastic to make the filaments resistant to deterioration due to ultra-violet and/or heat exposure.
2. Ensure the fabric is finished so that the filaments will retain their relative position with respect to each other.
3. Use fabric without defects, rips, holes, or flaws.
4. Use fabric meeting the following physical requirements for woven and non-woven fabric:

Woven Fabrics	
Tensile strength (any direction)	200 lbs (890 N) minimum
Bursting strength	500 psi (3.5 MPa) minimum
Elongation before breaking	10% to 35%
Percent open area	4.0% to 6.5%
Non-woven Fabrics	
Puncture resistance	30 lbs (135 N) minimum
Grab tensile strength	65 lbs (290 N) minimum
Grab elongation	40% minimum
Flow rate [H from 3 to 1 in (75 to 25 mm)]	50 gal/min/ ft ² (34 liters/second/m ²) (minimum) to 350 gal/ min/ft ² (240 liters/second/m ²) (maximum)

5. Use fabric evaluated by the National Transportation Product Evaluation Program (NTPEP).

6. Seams

- a. Get approval on the seams from the Engineer before use on a Project.
- b. Use fabric sewn with thread of the same chemical requirements as the fabric, or use fabric bound with cement or heat. Either have the fabric bound or sewn at the point of manufacture or at a location approved by the Engineer.
- c. Seam Uses: You may use one seam in edge drain and underdrain applications.
You may bond or sew fabric together to form sections at least 6 ft (1.8 m) wide for use under rip rap or behind retaining walls.

7. Fabric Use

- a. Use woven fabrics beneath rip rap when dropping stone from 3 ft (1 m) or less.
- b. You may use woven fabrics that meet the flow rate for edge drains.
- c. Use non-woven fabrics to line edge drains, underdrains, or behind retaining walls, where specified.
- d. Do not use non-woven fabrics for filter beneath rip rap.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

Test according to the following:

Test	Method
Puncture resistance	ASTM D 4833
Tensile strength, elongation, grab strength	ASTM D 4632
Bursting strength	ASTM D 3786
Percent open area	GDT 88
Flow rate	GDT 87

- 1. See [QPL 28](#) for acceptable woven and non-woven fabrics meeting the requirements of this Specification. See [QPL 47](#) for acceptable Geocomposite wall drains.
- 2. The Department will reject any fabrics that meet this Specification but fail to perform in actual use.

D. Materials Care and Warranty

Wrap fabric in burlap or similar heavy duty protection during shipment and storage to protect it from mud, dirt, dust, and debris.

881.2.06 Pavement Reinforcement Fabric

A. Requirements

Type I and Type II Pavement Reinforcement Fabric

- 1. Use pavement reinforcement fabric that has the following properties:
 - Is non-woven, heat-resistant material composed of polypropylene or polyester fibers
 - Can be saturated with asphalt cement
 - Can be placed smooth with mechanical devices and be without wrinkles
 - Can withstand the heat of asphaltic concrete mixes during paving operations
 - Can withstand normal field handling and construction operations without damage

For a list of sources, see [QPL 40](#).

- Meets the following physical requirements. The bid item or Plans will indicate which type of fabric is required for a Project.

	Type I	Type II

Tensile strength, minimum	90 lbs (400 N)	125 lbs (555 N)
Elongation at break	40% min., 100% max.	40% min., 100% max.
Asphalt retention, minimum	0.18 gal/yd ² (0.8 L/m ²)	0.28 gal/yd ² (1.3 L/m ²)

- Submit a certificate from the manufacturer showing the physical properties of the material used and how it meets this Specification. Submit the certificate according to [Subsection 106.05, "Materials Certification."](#)
- Demonstrate to the Department that fabric meeting the physical properties requirements of this Specification has been used successfully in installations with similar environmental and Project conditions.

High Strength Pavement Reinforcement Fabric

- Use pavement reinforcement fabric with the following properties:
 - Is a flexible, water-resistant, high-density asphaltic membrane laminated between two layers of high strength, heat resistant polypropylene or polyester fabric.
 - Can be placed smooth with mechanical devices and be without wrinkles.
 - Can withstand the heat of asphaltic concrete mixes during paving operations.
 - Can withstand normal field handling and construction operations without damage.
 - Has a self-adhesive backing adhered to a film release liner.

For a list of sources, see [QPL 40](#).

- Meets the following physical requirements. The bid item or Plans will indicate which type of fabric is required for a Project.

Width, minimum	18 in (450 mm)
Tensile strength, minimum	1,800 lbs/in ² (12 MPa)
Elongation	20% to 50%
Softening Point (Asphaltic membrane), minimum	190 °F (87 °C)
Caliper	0.135 inch (3.43 mm) 95% retained after loading
Pliability (Cold Flex) 2" (50 mm) X 5" (125 mm) specimen, condition specimen at 0 °F (-18 °C) for 1 hour, 180° bend on 2" (50 mm) mandrel	No Separation

- Submit a certificate from the manufacturer showing the physical properties of the material used and how it meets this Specification. Submit the certificate according to [Subsection 106.05, "Materials Certification."](#)
- Demonstrate to the Department that fabric meeting the physical properties requirements of this Specification has been used successfully in installations with similar environmental and Project conditions.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

Type I and Type II Pavement Reinforcement Fabric

Test according to the following:

Test	Method
Tensile strength	ASTM D 4632 Grab

Elongation	ASTM D 4632 Grab
Asphalt retention	GDT 95

High Strength Pavement Reinforcement Fabric

Test according to the following:

Test	Method
Tensile strength	ASTM D 412
Elongation	ASTM D 412
Softening Point	ASTM D 36
Caliper	ASTM D 1777
Pliability (Cold Flex)	ASTM D 146

D. Materials Warranty

General Provisions 101 through 150.

881.2.07 Silt Fence Filter Fabric

A. Requirements

1. Use approved silt fence from [QPL 36](#).
 - a. Type “A” and “B” Fences: Use either woven or nonwoven filter fabric for Type “A” and “B” fences. If using woven fabric, the fabric may have slit tape yarns in one direction (warp or fill) only.
 - b. Type “C” Fences: Use non-calendered woven fabric constructed with monofilament yarns only.

NOTE: Approved fabrics must consistently exceed the minimum requirements of this Specification as verified by the Office of Materials and Research. If a fabric is removed from the Qualified Products List, do not use it in the work until the Department has reestablished the product’s acceptability.

2. Ensure silt fence filter fabrics have the following characteristics:
 - Has strong rot-proof synthetic fibers formed into either a woven or non-woven fabric
 - Has no treatment or coating that might significantly alter its physical properties after installation
 - Contains stabilizers and/or inhibitors to make the filaments resistant to deterioration resulting from exposure to sunlight or heat
 - Makes a pervious sheet of synthetic fibers oriented into a stable network so that the fibers retain their relative position with respect to each other under normal handling, installation, and service conditions
 - Has finished fabric edges to prevent the outer yarn from pulling away from the fabric
 - Has no defects or flaws that would significantly affect its physical and/or filtering properties
 - Meets the following physical or dimensional requirements:

Type Fence	A	B	C
Minimum tensile strength, pounds (newtons) (1)	Warp – 120 (530) Fill – 100 (445)	Warp – 120 (530) Fill – 100 (445)	Warp– 260 (1155) Fill – 180 (800)
Elongation (% Max.)	40	40	40
Apparent opening size (max. sieve size)	No. 30 (600 um)	No. 30 (600 um)	No. 30 (600 um)
Flow rate, gal/ min./ft ² (L/min./m ²)	25 (1015)	25 (1015)	70 (2850)

Ultraviolet stability (2)	80	80	80
Bursting strength, psi (kPa)	175 (1200)	175 (1200)	175 (1200)
Minimum fabric width	36 in (914 mm)	22 in (559 mm)	36 in (914 mm)
1. Minimum roll average of five specimens. 2. Percent of required initial minimum tensile strength.			

3. Use silt fence filter fabrics evaluated by the National Transportation Product Evaluation Program (NTPEP).

B. Fabrication

The fabric may be manufactured with pockets for posts, hems with cord, or with posts pre-attached using staples or button head nails.

Ensure the fabric has the manufacturer’s name and product trade name labeled on the fabric at a minimum of 25 ft (7.6 m) intervals. Ensure the fabric has a color yarn mark in the fabric 14 inches (355 mm) ± 0.5 inch (12 mm) from both top and bottom ends for Type A and C and 8 inches (203 mm) ± 0.5 inch (12 mm) from both top and bottom ends for Type B fabric.

C. Acceptance

Test according to the following:

Test	Method
Tensile strength	ASTM D 4632
Elongation	ASTM D 4632
Apparent opening size	ASTM D 4751
Flow Rate	GDT 87
Ultraviolet stability	ASTM D 4632 (after 300 hours weathering according to ASTM D 4355)
Bursting strength	ASTM D 3786, Diaphragm Bursting Strength Tester

D. Materials Care and Warranty

Wrap fabric in a heavy-duty protective covering during shipment and storage to protect it from mud, dirt, dust and debris.

Do not expose fabric to temperatures greater than 140 °F (60 °C).

881.2.08 Filter Fabric for Embankment Stabilization

See Special Provision.

Office of Materials and Research

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA**

SPECIAL PROVISION

Section 882—Lime

Delete Section 882 and substitute the following:

882.1 General Description

This Section includes the requirements for agricultural lime; lime for subbase and subgrade stabilization; and lime for asphaltic concrete.

882.1.01 Related References

A. Specifications

General Provisions 101 through 150.

[Section 163 – Miscellaneous Erosion Control Items](#)

[Section 700 – Grassing](#)

[GSP 18](#)

B. Referenced Documents

AASHTO M 303

ASTM C 25

ASTM C 110

ASTM C 977

Liming Materials Act of 1996

882.2 Materials

882.2.01 Agricultural Lime

A. Requirements

Apply agricultural lime use rates made of ground or pelletized dolomitic limestone based on recommendations from a public or private Soil Laboratory that participates in a national proficiency testing program. Proof of testing is the responsibility of the Contractor. Provide a soil test report to the Engineer prior to application. Take soil test samples in accordance with [GSP 18 Sampling Testing and Inspection Specifications](#). Agricultural lime will meet the following requirements:

Requirements	Percent by Weight
Calcium Carbonates Equivalent, min.	85
Elemental magnesium derived from magnesium carbonate, min.	6
Passing No. 10 (2.00 mm) sieve, min	90
Passing No. 100 (150 µm) sieve, min	25

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

The Department will accept agricultural lime that meets the above requirements.

D. Materials Warranty

General Provisions 101 through 150.

882.2.02 Lime for Subbase and Sub-Grade Stabilization

A. Requirements

Use either a commercial dry hydrated lime or a commercial granular quicklime for soil stabilization.

1. Hydrated Lime: Use hydrated lime that meets the requirements of ASTM C 977, except use lime that has at least 85 percent by weight passing the No. 200 (75 μm) sieve.
2. Quicklime: Use quicklime that meets the requirements of ASTM C 977, except use lime that has 100 percent by weight passing the 3/8-inch (9.5 mm) sieve. If slurry is to be made from slaking quicklime, use quicklime containing at least 94 percent total calcium oxide and magnesium oxide (CaO + MgO), and at least 90 percent total available calcium oxide (CaO).
 - a. Furnish certified test reports with each shipment of lime attesting that the lime meets the requirements of the Specification. However, the Engineer may inspect, test, and reject the material at any time.
 - b. Lime from more than one source or more than one type on the same Project may be used, but do not mix lime of different types or from different sources.
 - c. Protect the lime from exposure until used. Ensure that the lime is dry enough to flow freely when handled.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

Test the hydrated and quicklime used for soil stabilization according to ASTM C 977.

D. Materials Warranty

General Provisions 101 through 150.

882.2.03 Lime for Asphaltic Concrete

A. Requirements

Use hydrated lime that meets the chemical and physical properties of AASHTO M 303, Type I.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

1. Run the chemical analysis of hydrated lime used in asphaltic concrete according to ASTM C 25.
2. Test the physical properties of the hydrated lime according to the residue test in ASTM C 110.

NOTE: [QPL 41](#) for lime is used in asphaltic concrete only.

3. See [QPL 41](#) for acceptable hydrated lime that meets the requirements of this Specification.

D. Materials Warranty

General Provisions 101 through 150.

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA**

Supplemental Specification

Section 883—Mineral Filler

Delete Section 883 and substitute the following:

883.1 General Description

This section covers mineral filler used as an ingredient in bituminous paving mixtures. Use mineral filler listed in the approved Asphalt Mix Design and Job Mix Formula and in Qualified Products List (QPL) 81. Use an approved mineral filler that meets the requirements below and consist of finely divided rock dust, slag dust, hydrated lime, hydraulic cement, or fly ash. Other fine, inert, non-toxic materials produced as by-products of industrial processes and meeting the requirements below may be approved as mineral filler based on satisfactory performance in the asphalt mix design procedure. Ensure mineral filler is sufficiently dry, flows freely, and is free from lumps.

883.1.01 Related References

A. Standard Specifications

General Provisions 101 through 150.

B. Referenced Documents

QPL81

AASHTO R 28

AASHTO T 240

AASHTO T 313

AASHTO T 315

GDT-22

GDT 123

883.2 Materials

883.2.01 Mineral Filler

A. Requirements

Use mineral filler meeting the following gradation limits:

Sieve Size	Percent Passing
No. 30 (600 μm)	100
No. 50 (300 μm)	95-100
No. 200 (75 μm)	55-100

Ensure that the mineral filler is free from impurities.

Subject mineral filler for use in Stone Matrix Asphalt (SMA) to mortar property testing according to AASHTO T-240, AASHTO R-28, AASHTO T-313, and AASHTO T-315. Mineral filler may be rejected and removed from QPL-81 for unsatisfactory performance as an ingredient in an asphalt mixture, as determined in these procedures or in the SMA Mix design procedure, GDT-123. Ensure the total fine mortar meets the following requirements:

Test	Specification
Unaged DSR, $G^*/\sin\delta$ (kPa)	5 minimum
RTFO Aged DSR, $G^*/\sin\delta$ (kPa)	11 minimum
PAV Aged BBR, Stiffness (MPa)	1500 maximum

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

Test gradation according to GDT-22.

D. Materials Warranty

General Provisions 101 through 150.

Office of Materials and Research

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA**

SPECIAL PROVISION

Section 891—Fertilizers

891.1 General Description

This section includes the requirements for fertilizers. Comply and meet the fertilizer requirements of the Georgia Fertilizer Act of 1997 and the Georgia Soil Amendment Act of 1976 which regulates labeling, sampling and tonnage reporting. Purchase all fertilizers through a Georgia registered licensed distributor. All fertilizer is subject to a sampling inspection by the Georgia Department of Agriculture.

891.1.01 Related References

A. Standard Specifications

General Provisions 101 through 150

Section 163

Section 700

Section 702

GSP 18

B. Referenced Documents

Georgia Fertilizer Act of 1997

Georgia Soil Amendment Act of 1976

891.2 Materials

891.2.01 Fertilizer

A. Requirements

1. Use commercial fertilizer as a single nutrient or mixed grade.
2. Apply fertilizer based on recommendations from a public or private Soil Laboratory that participates in a national proficiency testing program. Proof of testing is the responsibility of the Contractor. Provide a soil test report to the Engineer prior to application. Take soil test samples in accordance with GSP 18 Sampling, Testing and Inspection Specifications.
3. From this recommendation use single nutrient or mixed grade fertilizers containing the nutrients - nitrogen(N), phosphate (P_2O_5), and potash(K_2O) in amounts recommended by the soil test. Composted animal manure may be substituted for commercial fertilizer that meets the soil test recommendations. See web based Fertilizer Calculators to assist in determining the correct analysis and amounts to be applied according to the soil test.
4. Clearly label the analysis on the fertilizer container.
5. Apply fertilizer as a dry or liquid material, using equipment specifically designed for mixing and agitating the fertilizer. Dry or liquid fertilizer may be applied by use of a hydroseeder.
6. Any fertilizer that becomes caked or otherwise damaged, making it unsuitable for use, shall be replaced at the Contractor's expense.
- 7.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

The Department will accept fertilizer that meets the above requirements.

D. Materials Warranty

General Provisions 101 through 150.

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA
SPECIAL PROVISION**

Section 894—Fencing

Delete Subsection 894.2.0.6.A and substitute the following:

894.2.06 Silt Fabric Fencing

A. Requirements

1. Fabric

- a. See [Subsection 881.2.07, “Silt Fence Filter Fabric.”](#) for the types of fabric available.
- b. Use a woven wire support fence or a polypropylene support mesh with Type “C” fence.
 - 1) Woven Wire Support Fence
 - a) Ensure the woven wire support fence is at least 26 inches (660 mm) high with at least 6 horizontal wires.
 - b) Ensure the vertical wires have a maximum spacing of 12 in (155 mm).
 - c) Ensure the top and bottom wires are at least 10 gauge (2.49 mm) and all other wires are at least 12-1/2 gauge (2.03 mm). Use Washburn and Moen Standard requirements for determining wire gauge.
 - d) You may use other designs subject to approval by the Office of Materials and Research.
 - 2) Polypropylene Support Mesh
 - a) Ensure the polypropylene support mesh is sewn to the fabric 2 in (50 mm) ± 1 in (25 mm) from top and bottom of fabric and 11 in (279 mm) ± 1 in (25 mm) from top and bottom of fabric. Use a T-90 black polyester thread to sew mesh to fabric with a lock stitch at 5 to 7 stitches per inch.
 - b) Ensure the height of the polypropylene support mesh is at least 36 in (914 mm) with a plus tolerance of 1 in (25 mm).
 - c) Ensure the polypropylene support mesh minimum tensile strength in the machine direction is 60 lb/3 inches and 72 lb/3 inches in the transverse direction.
 - d) Ensure minimum average weight of the polypropylene support mesh is 10.3 lb/1000 ft².
 - e) Ensure the average strand count of the polypropylene support mesh in the machine direction is 9.0 ± 1.5 per 10 inches and 14.5 ± 0.7 per 10 inches in the transverse direction.
 - f) Ensure the polypropylene support mesh contains stabilizers and/or inhibitors that make the mesh resistant to deterioration from exposure to sunlight or heat.

2. Posts

Use post sizes and types as determined by the type of fence being installed. Generally hardwood posts will be limited to ash, hickory, or oak. Other hardwoods may be acceptable if approved by the Office of Materials and Research.

- a. Type “A” Fence: Use either wood or steel posts that are at least 4 ft (1.2 m) long.
 - 1) If using soft wood, use posts that are at least 3 in (75 mm) in diameter or nominal 2 x 4 in (33 x 89 mm) and straight enough to provide a fence without noticeable misalignment.

- 2) If using hardwood, use posts that are 1-1/2 x 1-1/2 in (38 x 38 mm) with a minus tolerance of 3/8 in (9 mm) providing the cross sectional area is at least 2.15 in² (1385 mm²).
 - 3) If using steel, use posts that are “U,” “T,” or “C” shaped with a minimum weight of 1.15 lb/ft (1.7 kg/m), and have projections for fastening the fence to the posts.
- b. Type “B” Fence: Use either wood or steel posts that are at least 3 ft (900 mm) long.
- 1) If using soft wood, use posts that are at least 2 in (50 mm) in diameter or nominal 2 x 2 in (33 x 33 mm).
 - 2) If using hardwood, use posts that are 1 x 1 in (25 x 25 mm) with a minus tolerance of 1/4 in (6 mm) providing the cross sectional area is at least 0.95 in² (610 mm²).
 - 3) If using steel posts, use types “U,” “T,” or “C” shapes with a minimum weight of 0.75 lb/ft (1.1 kg/m).
- c. Type “C” Fence:
- 1) Woven Wire Supported: Use only steel posts with a minimum length of 4 ft (1.2 m). Use “U,” “T,” or “C” shaped posts with a minimum weight of 1.15 lb/ft (1.7 kg/m). Use posts that have projections for fastening the woven wire and filter fabric.
 - 2) Polypropylene Mesh Supported: Use either wood or steel posts that are at least 4 ft (1.2 m) long.
 - a) If using soft wood, use posts that are at least 3 in (75 mm) in diameter or nominal 2 x 4 in (33 x 89 mm) and straight enough to provide a fence without noticeable misalignment.
 - b) If using hardwood, use posts that are 2 x 2 in (50 x 50 mm) with a minus tolerance of 1/4 in (6 mm) providing the cross sectional area is at least 3.28 in² (2120 mm²).
 - c) If using steel posts, use “U,” “T,” or “C” shaped posts with a minimum weight of 1.15 lb/ft (1.7 kg/m). Use posts that have projections for fastening the woven wire and filter fabric.

NOTE: You must use woven wire or polypropylene mesh to provide extra support for Type “C” fence installations.

3. Fasteners for Wooden Posts

- a. Wire Staples: Use staples that are at least 17 gauge (1.37 mm), legs at least 1/2 in (13 mm) long, and a crown at least 3/4 in (19 mm) wide.
- b. Nails: Use nails that are at least 14 gauge (2.03 mm), 1 in (25 mm) long, with button heads of at least 3/4 in (19 mm).

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA**

SPECIAL PROVISION

Section 895—Polyacrylamide (PAM)

895.1 General Description

This section covers the use of anionic Polyacrylamide (PAM) as a flocculant on construction projects.

895.1.01 Related References

A. Standard Specifications

[Section 700—Grassing](#)

B. Referenced Documents

[QPL 84](#)

895.2 Materials

A. Requirements

Use only Polyacrylamide (PAM) products listed on the Qualified Products List ([QPL 84](#)).

Ensure Polyacrylamide (PAM) emulsions and powders are of the **anionic type only** and meet the following requirements:

1. Meets the EPA and FDA acrylamide monomer limits of equal to or greater than 0.05% acrylamide monomer.
2. Has a density of 10% to 55% by weight and a molecular weight of 16 to 24 Mg/mole.
3. Mixture is non-combustible.
4. Contains only manufacturer recommended additives.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

1. Polyacrylamide (PAM) products must meet the requirements of [Section 895](#) and be listed on [QPL 84](#).
2. Provide manufacturer's data on charge density and molecular weight.

D. Materials Warranty

General Provisions 101 through 150.

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA**

SUPPLEMENTAL SPECIFICATION

Section 913—Reflectorizing Materials

Delete Section 913 and substitute the following:

913.1 General Description

This section includes the requirements for reflective sheeting.

913.1.01 Definitions

- Reflective Sheeting Types:
 - Type I: Medium-intensity retroreflective sheeting (engineering grade) that is typically an enclosed lens glass-bead retroreflective material.
 - Type II: Medium-high-intensity retroreflective sheeting (super engineering grade), that is typically enclosed lens glass-bead retroreflective material.
 - Type III: High-intensity retroreflective sheeting that is typically an encapsulated glass-bead retroreflective material.
 - Type IV: High-intensity retroreflective sheeting that is typically an unmetallized microprismatic retroreflective element material.
 - Type V: Super-high-intensity retroreflective sheeting that is typically a metallized microprismatic retroreflective element material. This material is typically used for delineators.
 - Type VI: Elastomeric high-intensity retroreflective sheeting without adhesive that is typically a vinyl microprismatic retroreflective material. This material is typically used for orange temporary roll up signs.
 - Type VII: Super-high-intensity retroreflective sheeting that is typically an unmetallized microprismatic retroreflective element material.
 - Type VIII: Super-high-intensity retroreflective sheeting that is typically an unmetallized microprismatic retroreflective element material.
 - Type IX: Very-high-intensity retroreflective sheeting that is typically an unmetallized microprismatic retroreflective element material.
 - Type X: Super-high intensity retroreflective sheeting that is typically an unmetallized microprismatic retroreflective element material.

913.1.02 Related References

A. Standard Specifications

General Provisions 101 through 150.

B. Referenced Documents

ASTM D 4956

[QPL 29](#)

913.2 Materials

913.2.01 Type I, II, III, IV, V, VI, VII, VIII, IX, and X Reflective Sheeting

A. Requirements

1. Use reflective sheeting that meets the requirements of ASTM D 4956.
2. Use reflective sheeting as listed in [QPL 29](#).
3. Use reflective sheeting that has been evaluated by the National Transportation Product Evaluation Panel (NTPEP) test facility or other approved test facility.
4. Submit the following to the Department:
 - a. A certificate with each lot or shipment stating the following:
 - The material supplied will meet all the test requirements listed herein.
 - You have performed the specified tests to ensure compliance.
 - You will submit test results upon request.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

1. The Engineer will reject reflective sheeting in the following situations:
 - a. The material fails to meet any one of the designated requirements.
 - b. The material meets the requirements but later fails during sign fabrication or in actual field use. Cracks, wrinkles, delamination, color change, or abnormal loss of reflectivity constitute failure.
 - c. Natural causes deteriorate the material to the extent that:
 - 1) The sign is ineffective for its intended purpose as defined in [Subsection 913.2.01.C.1.b](#) above.
 - 2) The average nighttime reflective brightness does not meet the outdoor weathering requirements of ASTM D4956.

D. Materials Warranty

Transfer to the Department a performance warranty for Type I, II, III, IV, V, VI, VII, VIII, IX, or X reflective sheeting issued by the manufacturer.

Ensure that the warranties cover the full replacement cost, including material and labor.

Include in these warranties a provision that the warranty is subject to a transfer to the Department.

Submit a warranty from the manufacturer that states that the reflective sheeting—processed, applied to sign blank materials, and cleaned—meets the outdoor weathering photometric requirements of ASTM D 4956.

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA**

SUPPLEMENTAL SPECIFICATION

Section 917—Reflectors and Nonreflective Characters

Delete Section 917 and substitute the following:

917.1 General Description

This section includes the requirements of demountable characters with Type IX reflective sheeting, and direct-applied, nonreflective characters.

917.1.01 Related References

A. Standard Specifications

[Section 106—Certification of Materials](#)

[Section 913—Reflectorizing Materials](#)

B. Referenced Documents

ASTM B 209 (B 209M)

ASTM D 822

917.2 Materials

917.2.01 Demountable Characters with Type IX Reflective Sheeting

A. Requirements

1. Use Type IX reflective sheeting letters, numerals, symbols, and borders that meet the requirements of [Subsection 913.2.02](#), Type IX.
2. Use a silver color, unless otherwise specified on the Plans.
3. Apply the characters to aluminum flat frames as recommended by the sheeting manufacturer.
4. Use flat frames (letter, numerals, symbols and borders) made from aluminum sheet 0.032 in (0.813 mm) thick matching ASTM B 209 (209M), Alloy 3003-H14.
5. Submit to the Department:
 - One letter of a predominant size and type to be used on the Project.
 - A certificate to the Engineer stating that the material used on the Project is the same as the sample submitted.

B. Fabrication

1. Before applying any sheeting, properly degrease, etch, and treat each frame with a light, tight amorphous chromate-type coating.
2. Mechanically apply the reflective sheeting to the prepared flat aluminum frames. Use the proper equipment as prescribed by the sheeting manufacturer.
3. When recommended by the sheeting manufacturer, coat the completed demountable letters, numerals, symbols and borders with a clear finish approved by the sheeting manufacturer.
Apply the clear coat to the sheeting surface to ensure the sheeting has a fully glossy coat and a complete edge seal.

4. Ensure that the finished letters, numerals, symbols, and borders show careful workmanship, are clean cut, sharp, and have a plane surface.
5. Use the character size and shape to determine the hole spacing to mount the frame with aluminum rivets or other approved non-corrosive fasteners. Do not space holes more than 8 in (200 mm) on center.

C. Acceptance

The Department will accept the material based on test results of samples taken by the Department or of samples submitted by the manufacturer or fabricator, when directed. The sample shall consist of one letter of predominant size and type to be used on the Project. Samples submitted by the manufacturer or fabricator to the Engineer, shall include a certificate stating that the material used on the Project is the same as the sample submitted.

D. Materials Warranty

General Provisions 101 through 150.

917.2.02 Direct Applied Nonreflective Characters

A. Requirements

1. Use direct-applied, nonreflective characters as opaque legend, stripping, and symbols on traffic control signs made from reflective sheeting that meets [Subsection 913.2](#).
2. Use nonreflective, weatherproof plastic film that is precoated with pressure-sensitive or heat-sensitive adhesive backing.
3. Use sheeting that is flexible enough to be easily cut, shaped, and applied over reflective sheeting.
4. Submit the manufacturer's certification to the Engineer showing the properties of the materials used and how they match the Specifications, as required by [Subsection 106.05, "Materials Certification."](#)
5. Ensure that the nonreflective sheeting is weather resistant after processing and application, according to the manufacturer's recommended procedures.
 - a. Expose the nonreflective sheeting for 1,200 hours in an Atlas Twin Arc Weatherometer, as per ASTM D 822.
 - b. Clean the sheeting.
 - c. The Department will reject nonreflective sheeting that appreciably discolors, cracks, crazes, blisters, changes dimensionally, or adversely effects the reflective sheeting on which it is mounted.
6. Use adhesive that has the following characteristics:
 - Is precoated and pressure-sensitive (Class 1) or tack-free and heat-activated (Class 2). Be able to apply either without adding more adhesive to either the nonreflective sheeting or to the reflective sheeting.
 - Has a protective liner that can be peeled off without being soaked in water or other solvents.
 - Ensure that the liner is easily removed after accelerated storage for 4 hours at 150 °F (65 °C) under 2.5 psi (17 kPa) of pressure.
 - Forms a durable, vandal-resistant bond to smooth and weather resistant surfaces.
 - Adheres securely at temperatures ranging from -30 ° to 200 °F (-35 ° to 95 °C), just 48 hours after application.
 - Prevents the sheeting from shocking off the panel when struck at -10 °F (-25 °C).

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

The Department will accept the material based on the manufacturer's certificate.

D. Materials Warranty

General Provisions 101 through 150.

Office of Materials & Research

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA**

SUPPLEMENTAL SPECIFICATION

Section 919—Raised Pavement Markers

Delete Section 919 and substitute the following:

919.1 General Description

This section includes the requirements for raised pavement marker materials for use in reflective, ceramic, and channel markers.

919.1.01 Related References

A. Standard Specifications

General Provisions 101 through 150.

B. Referenced Documents

ASTM C 424

ASTM C 373

ASTM D 2240

ASTM D 4280

Federal Method TT-T-141, Method 4252

919.2 Materials

A. Requirements

Do not use any marker materials until the laboratory approves it.

1. Use raised pavement marker sources as listed in [QPL 76](#).
2. Use raised pavement markers of the type shown in the Plans or specified in the proposal. This Specification references markers as follows:

Type	Description
1	Two-way, one-color, 4 x 2 in (100 mm x 50 mm), reflective
2	One-way, one-color, 4 x 2 in (100 mm x 50 mm), reflective
3	Two-way, two color, 4 x 2 in (100 mm x 50 mm), reflective
4	Round white, yellow or black ceramic, non reflective
5	Oval white, yellow or black ceramic, non-reflective
6	Oval white or yellow ceramic, reflective
7	White or yellow ceramic jiggle bar, non-reflective
8	White or yellow ceramic jiggle bar, reflective
9	White or yellow channel, non-reflective
10	White or yellow channel, reflective
11	Two-way, one-color, 4 x 4 in (100 mm x 100 mm), reflective

Section 919—Raised Pavement Markers

12	One-way, one color, 4 x 4 in (100 mm x 100 mm), reflective
13	Two-way, two color, 4 x 4 in (100 mm x 100 mm), reflective
14	Two-way, one color, flexible reflective
15	One-way, one color, flexible reflective

3. Certification

Submit a certification to the Engineer from the manufacturer showing the physical properties of the markers and their conformance to this Specification.

4. Packaging

Pack shipments in containers that are acceptable to common carriers.

- a. Pack the containers to ensure delivery in perfect condition.
- b. Clearly mark each package of pavement markers with the size, color, type, and lot number.
- c. You are liable to replace any damaged shipments.

919.2.01 Raised Retro-Reflective Pavement Markers (Type 1, 2, 3, 11, 12, and 13)

A. Requirements

1. Use raised retro-reflective pavement makers that meets the requirements of ASTM D 4280, designation H.
2. Use raised retro-reflective pavement makers as listed in QPL 76.
3. Use raised retro reflective pavement makers that have been evaluated by the National Transportation Product Evaluation Panel (NTPEP) test facility or other approved test facility.

B. Fabrication

General Provisions 101 through 150

C. Acceptance

The Department will give conditional and final approval to retro reflective pavement markers evaluated by the National Transportation Product Evaluation Program (NTPEP), the Georgia Department of Transportation, or other Department-approved test facilities and place them on QPL 76.

All white and yellow retro reflective pavement markers must meet the requirements of this Specification and the following NTPEP field performance requirement.

- a. **Conditional QPL Placement:** The Department may add markers on a conditional basis to QPL 76. These markers must maintain an average coefficient of luminous intensity for 12 months during the NTPEP evaluation of not less than 25% of the values shown in Table 1 of ASTM D 4280.
- b. **Final QPL Approval or Rejection:** The Department will approve or reject markers based on the marker maintaining an average coefficient of luminous intensity of 0.2 cd/fc for 24 months during the NTPEP evaluation.

919.2.02 Flexible Reflective Markers (Type 14 and 15)

A. Requirements

Use markers manufactured by extruding plastic into an “L” shape, with nominal dimensions of 4 in (100 mm) long x 2 in (50 mm) high (vertical face) x 1 in (25 mm) wide (base leg). Ensure that the markers have the following:

- A pressure-sensitive adhesive with a paper release liner to the bottom of the base leg.
- Strips of metallized acrylic reflective sheeting on either one or both sides of the vertical face.
- A clear plastic cover to protect the reflective strip. Ensure that the cover withstands a chip-seal operation and is easily removed after the operation.

1. Hardness

- a. Select five random markers
- b. Use ASTM D 2240 to determine the Shore A hardness
- c. The Department will reject markers whose body and clear protective cover hardness is less than 80.

Section 919—Raised Pavement Markers

B. Fabrication

General Provisions 101 through 150.

919.2.03 Ceramic Pavement Markers (Type 4, 5, 6, 7, and 8)

A. Requirements

1. Use ceramic pavement markers made from a heat-fired, white, vitreous, ceramic base and a heat fired, opaque, glazed surface to produce the properties required in these Specifications.
 - a. Do not place glaze on the marker bottom where it connects to the road surface.
 - b. Thoroughly and evenly mature the markers. Ensure that they have no defects that affect appearance and serviceability.
 - c. Use reflective ceramic markers that meet the specific intensity of each reflective surface according to Table 1 of ASTM D 4280.
 - d. Ensure that the mean thickness of the glazed surface is at least 0.005 in (0.13 mm) when measured at least 0.25 in (6 mm) from the edge of the marker.
 - e. Ensure that the water absorption of the ceramic markers does not exceed 2 percent of the original dry weight when tested according to ASTM C 373.
 - f. Ensure that the glazed surface does not craze, spoil, or peel when passed through one cycle of the Autoclave test at 250 psi (1724 kPa) (ASTM C 424).
2. Use the designated colors for the white and yellow markers.
 - a. Ensure that the colors are uniform.
 - b. Ensure that black matches Federal Color No. 595-27038.
 - c. Determine the color by visually comparing each marker with calibrated standards having CIE Chromaticity Coordinate limits. Determine the limits with Federal methods of test TT-T-141, Method 4252, using a rectangle with the following corner points:

	1		2		3		4		(90MGO)
White	.290	.316	.310	.296	.330	.320	.310	.344	80 min.
Yellow	.435	.485	.445	.435	.544	.456	.516	.484	50 min.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

1. Use a random sample of five markers for lens impact strength, temperature cycling and compressive strength tests specified in ASTM D 4280.
2. Use the following table to determine if the markers pass the tests.

Markers that Pass	Department Action
5 of 5	Accept the lot.
3 or less of 5	Reject the lot; no resample allowed.
4 of 5	The Contractor may request a retest. The Department will retest an additional 25 random markers in the test or tests where the original sample failed.
20 of 25 retested	Accept the lot.
19 or less of 25 retested	Reject the lot; no resample allowed.

3. Compressive Strength Test
 - a. The markers pass if the average compressive load of all five markers is at least 1,500 psi (6.7 kN). No individual marker shall be less than 1,200 psi (5.3 kN).

Section 919—Raised Pavement Markers

D. Materials Warranty

General Provisions 101 through 150.

919.2.04 Channel Pavement Markers (Type 9 and 10)

A. Requirements

1. Use channel pavement markers made of either a heat-fired, white, vitreous, ceramic base with a heat-fired, opaque, glazed surface, or a 9 gauge (3.9 mm) steel body with a heat-fired porcelain finish.
 - a. Ensure both ceramic and steel channel markers have no defects that affect appearance and serviceability.
 - b. Ensure that the mean thickness of the glazed surface of ceramic channel markers is at least 0.005 in (0.13 mm) when measured at least 0.25 in (6 mm) from the edge of the marker.
 - c. Ensure that mean thickness of the porcelain finish on the steel channel markers is at least 0.030 in (0.76 mm).
 - d. Ensure that the water absorption of the ceramic markers does not exceed 2.0 percent of the original dry weight when tested according to ASTM C 373.
 - e. Ensure that the surface of the markers do not craze, spoil, or peel when passed through one cycle of the Autoclave test at 250 psi (1724 kPa) (ASTM C 424).
2. Use the designated colors for the white and yellow markers.
 - a. Ensure that the colors are uniform.
 - b. Determine the color by visually comparing them with calibrated standards having CIE Chromaticity Coordinate limits. Determine the limits with Federal methods of test TT-T-141, Method 4252, using a rectangle with the following corner points:

	1		2		3		4		(90MGO)
White	.290	.316	.310	.296	.330	.320	.310	.344	80 min.
Yellow	.435	.485	.445	.435	.544	.456	.516	.484	50 min.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

1. Ensure that Type 10 markers meet the specific intensity of each reflective surface according to Table 1 in ASTM D 4280.
2. Use a random sample of five markers for lens impact strength, temperature cycling and compressive strength tests specified in ASTM D 4280.
3. Select two of the five markers and subject them to all the required tests.
4. Use the following table to determine if the markers pass the tests.

Markers that Pass	Department Action
2 of 2	Accept the lot.
0 of 2	Reject the lot; no resample allowed.
1 of 2	Retest the three remaining markers.
3 of 3 retested 2 or less of 3 retested	Accept the lot. Reject the lot; no resample allowed

D. Materials Warranty

General Provisions 101 through 150.

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA**

Special Provision

Section 925—Traffic Signal Equipment

Delete Section 925 and substitute the following:

925.1 General Description

This section provides Specifications for a variety of traffic signal equipment. Ramp Meters are defined as a form of traffic signalization and all general provisions for traffic signalization are applicable unless otherwise noted in the Plans and Specifications.

925.1.01 Related References

A. Standard Specifications

[Section 500—Concrete Structures](#)

[Section 639—Strain Poles for Overhead Sign and Signal Assemblies](#)

[Section 647—Traffic Signal Installation](#)

[Section 682—Electrical Wire, Cable and Conduit](#)

[Section 833—Joint Fillers and Sealers](#)

[Section 861—Piling and Round Timber](#)

[Section 870—Paints \(Field Painting\)](#)

[Section 915—Mast Arm Assemblies](#)

[Section 922—Electrical Wire and Cable](#)

[Section 923—Electrical Conduit](#)

[Section 926 – Wireless Communication Equipment](#)

[Section 927 – Wireless Communication Installation](#)

[Section 935—Fiber Optic System](#)

[Section 937 – Video Detection System](#)

[Section 939—Communications and Electronic Equipment](#)

B. Referenced Documents

- National Electrical Manufacturers Association (NEMA) Standards Publication TS 1 Section 15
- NEMA Standard Publication TS 2- 1998
- Institute of Transportation Engineers (ITE)Vehicle Traffic Control Signal Heads Specification
- ITE Vehicle Traffic Control Signal Heads: Light Emitting Diode (LED)Circular Signal Supplement June 27, 2005 Specification
- ITE Vehicle Traffic Control Signal Heads – Part 3: Light Emitting Diode (LED) Vehicle Arrow Traffic Signal Modules Specification
- ITE Pedestrian Traffic Control Signal indications – Part 2: Light Emitting Diode (LED) Pedestrian Traffic Signal Modules Specification
- International Municipal Signal Association (IMSA) #20-1 Specification
- IMSA #20-4Specification

Section 925—Traffic Signal Equipment

- IMSA #20-6 Specification
- IMSA #50-2 Specification
- IMSA #51-1 Specification
- Underwriters Laboratory Inc. (UL) 94 Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
- UL 493 Standard for Safety for Thermoplastic-Insulated Underground Feeder and Branch-Circuit Cables
- Traffic Signal Control Equipment Specifications, January 1989 edition and applicable addenda, State of California Business, Transportation & Housing Agency
- State of California Department of Transportation (CALTRANS) Qualified Products List (QPL) Controller Assemblies for the Model 170/2070 Traffic Controller,
- CALTRANS Transportation Electrical Equipment Specifications (TEES) August 16, 2002 and applicable addenda
- Georgia Department of Transportation Qualified Products List 75 “Polyurethane Sealant for Inductive Loops” (American Society of Testing and Materials (ASTM) A36 Standard Specification for Carbon Structural Steel
- ASTM A53 Standard Specification for Pipe, Steel, Black and Hot Dipped, Zinc-Coated, Welded and Seamless
- ASTM A123 Standard Specification for Zinc (Hot-Dip Galvanized) Coating on Iron and Steel Products
- ASTM A153 Standard Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware
- ASTM A325 Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
- ASTM A475 Standard Specification for Zinc-Coated Steel Wire Strand
- ASTM A572 Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
- ASTM C1028 Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method
- ASTM D256 Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics
- ASTM D638 Standard Test Methods for Tensile Properties of Plastics
- ASTM D785 Standard Test Method for Rockwell Hardness of Plastics: Electrical Insulating Materials
- ASTM D790 Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
- ASTM D2444 Standard Test Methods for Determination of the Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup
- ASTM D543 Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents

925.2 Materials

925.2.01 General

A. Requirements

Ensure that the traffic signal equipment and materials meet the Plans and Specifications.

All equipment furnished shall be new and meet the requirements of the following:

- Underwriter’s Laboratory Incorporated (UL)
- Electronic Industries Association (EIA)
- National Electric Code (NEC)
- American Society of Testing and Materials (ASTM)
- American National Standards Institute (ANSI)
- International Municipal Signal Association (IMSA)
- National Electrical Manufacturers Association (NEMA)
- Applicable Standards, Specifications, and Regulations of the:

Section 925—Traffic Signal Equipment

Georgia Department of Transportation
Traffic Signal Electrical Facility & NaviGator Support (TSEF)
935 E. Confederate Avenue, Building 5
Atlanta, GA 30316

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

General Provisions 101 through 150.

D. Materials Warranty

- Provide to the District Signal Engineer or maintaining agency all manufacturers' warranties and guarantees for all signal equipment items listed in this document as well as any signal equipment listed in the Plans, except for state supplied equipment.
- Ensure that warranties and guarantees are consistent with those provided as customary trade practices; or as otherwise specified in the Plans, Standard Specifications, Supplemental Specifications or Special Provisions.
- Ensure, and state, that manufacturer's and supplier's warranties and guarantees are transferable to the agency or user that is responsible for traffic signal maintenance. And said warranties and guarantees are continuous throughout their duration.
- Ensure equipment provided under this specification shall be warranted by the manufacturer to be free from defects in materials and workmanship for a minimum period of two years from date of receipt or one year from date of acceptance of installation. The exception is the other materials stated in this specification which have longer warranty durations.
- Ensure the manufacturer will repair any faulty equipment during this period at no charge to the Department for parts, labor or shipping to and from the factory.

925.2.02 Type 2070 Controller Assemblies

A. Requirements

For 2070 controller cabinet assemblies, use 2070 controller units that meet the requirements of the following or are previously approved by TSEF:

- *Traffic Electrical Equipment Specifications (TEES)* published by the State of California Business, Transportation, and Housing Agency; Department of Transportation, current edition and current addenda
- CALTRANS Qualified Products List (QPL)
- Ensure the unit supplied is compatible with current GDOT licensed firmware.

The following Specifications augment the CALTRANS Specifications and take precedence over conflicting CALTRANS Specifications.

1. Input/output (I/O) and Configuration:

The 2070 Controller shall be supplied in one of the following configurations, as specified in the Plans (all modules are specified in TEES, but these configurations supersede the defined configurations in TEES):

- 2070L: Provide Chassis, 2070-1B Single-Board CPU, 2070-2A Field I/O Module, 2070-3B Front Panel (8x40 display), 2070-4B 3.5-amp Power Supply, and a 2070-7A Module. This unit is intended for interfacing in Type 170E or ITS cabinets and shall provide the default input and output configuration as shown in Tables 925-13, 925-15 and 925-16 for ITS cabinets using a traffic signal application.
- 2070LC: Provide Chassis, 2070-1B Single-Board CPU, 2070-2B Field I/O Module, 2070-3B Front Panel (8x40 display), 2070-4B 3.5-amp Power Supply, and a 2070-7A Module. This unit is intended for interfacing in ITS cabinets only and shall provide the default input and output configuration as shown in Tables 925 -13, 925-15 and 925-16 for ITS cabinets using a traffic signal application.
- 2070 LB: Provide Chassis, 2070-1B Single –Board CPU, 2070-2A Field I/O Module, 2070-3C Front Panel, 2070-4B 3.5-amp Power Supply, This unit is intended for interfacing in Type 170E or ITS cabinets where a user interface is not required and shall provide the default input and output configuration as shown in Tables 925 -13, 925-15 and 925-16 for ITS cabinets using a traffic signal application.

Section 925—Traffic Signal Equipment

- 2070 LN1: Provide Chassis, 2070-1B Single-Board CPU, 2070-2B Field I/O Module, 2070-3B Front Panel (8x40 display), 2070-4NB 3.5-amp Power Supply, 2070-8 NEMA Interface Module, and a 2070-7A Module. This unit is intended for interfacing in NEMA TS 1 or NEMA TS 2 Type 2 cabinets.
- 2070 LN2: Provide Chassis, 2070-1B Single-Board CPU, 2070-2N Field I/O Module, 2070-3B Front Panel (8x40 display), 2070-4NB 3.5-amp Power Supply, and a 2070-7A Module. This unit is intended for interfacing in a NEMA TS 2 Type 1 cabinet.

2. Power Supply Modules:

Either the 2070-4A, 2070-4B, 2070-4NA or 2070-4NB module shall be provided as required in the configuration requirements in the preceding Item. In addition to all requirements of the TEES, the power supplies shall be clearly marked as a “2070-4A”, “2070-4B”, “2070-4NA”, or “2070-4NB”. The Vendor may supply a 2070-4A or 4NA power supply module in lieu of a 2070-4B or 4NB, as long as it is so marked and adds no additional cost to GDOT.

3. Documentation:

Include with each controller, manuals that document the programming, operation, and maintenance of the unit. Include schematic drawings and pin assignment charts in the manuals for maintenance. Documentation shall include all components, including communications modules. Specific reference is made to section 1.2.4 Documentation in the CALTRANS TEES concerning required documentation to be provided.

4. Testing:

Provide for complete testing of unit before it is shipped. If unit is shipped with applications firmware installed, it must be tested with the application (e.g. Traffic Signal Control). If a random sample of greater than 10 percent of the units tested is rejected then the total shipment shall be rejected and vendor will be responsible for all costs to test and repair all units provided.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

See Subsection 925.2.01 for compliance with CALTRANS QPL. Also see item 4 Testing in Section A above.

D. Materials Warranty:

(See Subsection 925.2.01 D for Materials Warranties).

925.2.03 Type 2070 Controller Subassemblies

A. Requirements

For 2070 controller subassemblies, use 2070 controller subassembly units that meet the requirements of the following or are previously approved by TSEF:

- *Traffic Electrical Equipment Specifications (TEES)* published by the State of California Business, Transportation, and Housing Agency; Department of Transportation, current edition and current addenda
- CALTRANS Qualified Products List (QPL)

The following Specifications augment the CALTRANS Specifications and take precedence over conflicting CALTRANS Specifications.

1. 2070 1B Module:

The 2070 1B module may be supplied as a separate item to be used in all versions of the 2070 controller. The 2070 1B module shall be supplied complete with the operating software. Ensure it contains the required files to be compatible with the current GDOT applications software.

2. 2070 2A Field I/O Module

The 2070 2A Field I/O module may be supplied as a separate item. The 2070 2A Field I/O module shall consist of the Field Controller Unit; Parallel Input/Output Ports; other Module Circuit Functions (includes muzzle jumper); Serial Communication Circuitry; Module Connectors C1S, C11S and C12S mounted on the module front plate; VDC Power Supply (+12VDC to + 5VDC) and required software. Ensure it contains any configuration jumpers to be compatible with current GDOT Applications software. Ensure the 2070 2A field I/O Module functions with a Model 2070L or 2070LB Controller Assembly and is compatible with current GDOT applications software.

3. 2070 2B Field I/O Module:

The 2070 2B Field I/O module may be supplied as a separate item and consist of the Serial Communication Circuitry, DC power Supply, and Module Connector 12S mounted on the module front plate only. Ensure it contains any configuration jumpers to be compatible with current GDOT Applications software. Ensure the 2070 2B field I/O Module functions with a Model 2070 LC or 2070LN1 Controller Assembly and is compatible with current GDOT applications software.

4. 2070 2N Field I/O Module:

The 2070 2N Field I/O module may be supplied as a separate item and provides a NEMA TS2-1 compatible SDLC interface via Serial Port 3. AC power to the 2070 Unit and Fault Monitor Logic Output via 2070 Serial Port 5 and Output Frame Byte 9 Bit 6 to the NEMA TS2 Cabinet Monitor Unit (CMU). Ensure it contains any configuration jumpers to be compatible with current GDOT Applications software. Ensure the 2070 2N field I/O Module functions with a Model 2070 LN2 Controller Assembly and is compatible with current GDOT applications software.

5. 2070 3B Front Panel Display Module:

The 2070 3B Display Module may be supplied as a separate item and provides a Front Panel Assembly controller, two keyboards, AUX switch alarm bell and an 8 line by 40 character display. This assembly shall also include a panel with latch assembly and two TSD #1 hinge attaching devices, assembly PCB, external serial port connectors, CPU active LED indicator, contrast adjustment knob, and Front Panel Harness. Ensure it contains any configuration jumpers to be compatible with current GDOT Applications software. Ensure the 2070 3B Front Panel Assembly Module functions with Models 2070L, 2070LC, 2070LN1 and 2070 LN2 Controller Assemblies and is compatible with current GDOT applications software. Ensure the hardware hinge attaching devices mate with existing 2070 assemblies. Ensure the Front Panel Harness is connected to the front panel via a removable connector. Ensure the front panel connector supports the aux switch.

6. 2070 3C Front Panel Display Module:

The 2070 3C Display Module may be supplied as a separate item and provides a System Serial Port 6 Lines, Isolated and vectored to Connector C60S. This assembly shall also include a panel with latch assembly and two TSD #1 hinge attaching devices, assembly PCB, external serial port connectors, CPU active LED indicator, and Front Panel Harness. Ensure it contains any configuration jumpers to be compatible with current GDOT Applications software. Ensure the 2070 3B Front Panel Assembly Module functions with Model 2070LB Controller Assembly and is compatible with current GDOT applications software. Ensure the hardware hinge attaching devices mate with existing 2070 assemblies. Ensure the Front Panel Harness is connected to the front panel via a removable connector. Ensure the front panel connector supports the aux switch.

7. 2070 4B Power Supply Module:

The 2070 4B Power Supply Module may be supplied as a separate item and is an independent, self contained module. Ensure that it is vented and cooled by convection only. Provide module that slides into power supply compartment from the back of the chassis and is attached to the Backplane mounting surface by its four TSD #3 Devices. Ensure the module supplies at least 3.5 amperes of +5VDC. Ensure the 2070 4B Power Supply Module is compatible with Models 2070L, 2070LB, and 2070LC Controller Assemblies and is compatible with current GDOT applications software. Ensure the connection harness PS 2 on existing units can be mated with the 4B module supplied. A 2070 4A Power Supply Module may be provided in place of a 4B module as long as it is labeled as such and there is no additional cost to GDOT. Ensure the module supplied is appropriately marked as a 4B or 4A module.

8. 2070 4NB Power Supply Module:

The 2070 4NB Power Supply Module may be supplied as a separate item and is an independent self contained module. Ensure that it is vented and cooled by convection only. Provide module that slides into power supply compartment from the back of the chassis and is attached to the Backplane mounting surface by its four TSD #3 Devices. Ensure the module supplies at least 3.5 amperes of +5VDC. Ensure the 2070 4B Power Supply Module is compatible with Models 2070 LN1 and 2070 LN2 Controller Assemblies and is compatible with current GDOT applications software. Ensure the connection harness PS 2 on existing units can be mated with the 4B module supplied. Ensure the 4NB power supply module supports the NEMA TS1 and TS2 Standards. A 2070 4A Power Supply Module may be provided in place of a 4B module as long as it is labeled as such and there is no additional cost to GDOT. Ensure the module supplied is appropriately marked as a 4NA or 4NB module.

9. 2070 6B Communications Module:

The 2070 6B Communications Module is supplied as a separate item. The 6B communications module is a dual async/modem serial module. Ensure the module supports both Serial and modem FSK communications on both of two separate ports. Ensure the Modem data baud rate supports 0 to 9600. Ensure the module is configured to support

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FSK communications on the C2S connection. Ensure it contains any configuration jumpers to be compatible with current GDOT Applications software.

10. 2070 7A Communications Module:

The 2070 7A Communications Module may be supplied as a separate item. The 7A communications module is a dual async serial communications module. Ensure the module supports serial communications on both ports. Ensure it contains any configuration jumpers to be compatible with current GDOT Applications software.

11. 2070 8 Field I/O Module:

The 2070 8 Field I/O Module may be supplied as a separate item. The 8 Field I/O Module consists of the module chassis, module power supply, Field Control Unit Controller, parallel input/output ports, serial communications circuits and module connectors. Ensure the EX1 connector is provided with appropriate mating connections to interface with either 6B or 7A communications modules. Ensure the 2070 8 Field I/O module is provided with the appropriate mating connector to mate with the C12S connector on the 2070 2B Field I/O module. Ensure the 2070 8 Field I/O module functions as part of a Model 2070 LN1 controller.

12. 2070 D Panel:

The 2070 D panel is supplied as a separate item. The 2070 D panel supports the inputs and outputs of the “D” connector provided on a 2070-8 module which is also part of a Model 2070 LN1. Ensure the “D” Connector panel supports all 61 pins with a connecting MS “D” connector and terminal blocks. Ensure the 2070 D Panel provides adequate cable length to allow attachment in an existing NEMA Cabinet. Ensure that the terminal blocks allow for two connections.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

(See Subsection 925.2.01 for compliance with CALTRANS QPL).

D. Materials Warranty:

(See Subsection 925.2.01.D for Materials Warranties).

925.2.04 Cabinet Assemblies

A. Requirements

In addition to the CALTRANS Specifications, ensure that the cabinet assembly conforms to the requirements listed below, which take precedence over conflicting CALTRANS Specifications.

1. Cabinet configuration:

Supply cabinets in accordance with these Specifications. Equip the cabinets with auxiliary equipment as follows:

a. Model 332A Cabinet:

Lower input field termination panel

1 – Model 242 DC Isolator in Slot 14 of Upper Input File

4 – Flash Transfer Relays

2 – Model 204 Flashers

1- Auxiliary Cabinet Shelf to support Communication Devices

1- 4 Position Power Strip

1- Manual push button assembly

b. Model 336S Cabinet:

1-Model 242 DC Isolator in Slot 14 of Input File

4- Flash Transfer Relays

2-Model 204 Flashers

1- Auxiliary Cabinet Shelf to support Communication Devices

1- 4 Position Power Strip

- 1- Manual push button assembly
- 1-"M" Base Adapter installed (Base Mount Cabinets Only)
- 1-Aluminum Cover Plate for Cabinet Bottom (Pole Mount Cabinets Only)
- c. Model 337 Cabinet
 - 3-Flash Transfer Relays
 - 1-Model 204 Flasher
 - 1- Manual push button assembly
- d. Model 334 Cabinet with Auxiliary Output File for Ramp Metering Operations
 - 1- Auxiliary Equipment Shelf
 - 1- Output/PDA Type 3 with Model 206 24 Volt DC Power Supply with flash transfer relay
 - 1- Model 208 Monitor Unit
 - 1- Model 420 Auxiliary Output File
 - 1-Load Switch Model 200
 - 1- 4 Position Power Strip
 - 1- Lower Input Field Termination Panel
 - 1- Detector Test Switch Panel

Note: Include above components in cabinet at time of delivery.

Other auxiliary cabinet components such as controllers, monitors, load switches, etc. will be ordered as separate items.

2. Finish

Use cabinets that have a bare aluminum finish (see [Subsection 925.2.07.A.1](#) for controller-cabinet minimum fabrication Specifications).

3. Locks

Equip the main cabinet door with locks that accept No. 2 Corbin keys. Provide two sets of keys with each cabinet. One set of keys is defined as one – No. 2 key and one - police panel key.

4. Power

Equip the cabinet assemblies with a power distribution assembly to generate AC and DC power for the electronic components, except the DC power for the controller units. Provide the Model 332 and 336S cabinets with a DC isolator for stop time/flash sense, located in slot 14 of the input file.

5. Mounting

Equip the cabinets for pole or base mounting, as specified in the Plans.

a. Base Mount

Supply Model 336S cabinets, when specified as base mount, with a “M” base-mounting adapter installed.

b. Pole Mount

Supply Model 336S or 337 cabinets, when specified as pole mount, with two exterior pole mounting brackets that allow for mounting on steel, concrete, and timber poles.

Ensure that the bracket mounting holes are properly reinforced with metal plates of adequate size and strength, welded longitudinally across the inside depth of the cabinet.

Ensure that the exterior-mounting bracket is shipped installed on the cabinet housing. Additionally, provide an aluminum plate, which covers the bottom cabinet opening.

6. Unused Phase Monitoring

Provide odd-phase reds with ballast resistor (2K, 10 watt) dummy loads. Do not wire the cabinet to monitor pedestrian yellow indications. When auxiliary output file is used provide resistors for overlaps.

Neatly lace, label and bundle the wiring from the signal monitor for pedestrian yellow monitoring on the back panel.

7. Red Monitoring

Provide a connector and terminal assembly designated as P20 for monitoring the absence of red as an integral part of the output file. Terminate the connector and ensure compatible with the cable and C connector of a Type 2010 conflict monitor unit capable of monitoring the absence of red.

Provide the pin assignments of the P20 connector and terminal assemble with the cabinet Plans.

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Ensure that the P20 connector is physically alike to the cable and connector of a Type 2010 conflict monitor unit to prevent the absence of red cable connector from being inserted into the P20 connector 180 degrees out of alignment. Submit details for programming of the unused red channels for approval.

8. Cabinet Light

Include in each cabinet one fluorescent strip lighting fixture mounted inside the top front portion of the cabinet. Do not use screw in type fluorescent lamp.

The fixture includes a cool white lamp, covered, and operated by a normal power factor, UL listed ballast.

Install a door-actuated switch to turn on the cabinet light when either door is opened.

9. Cabinet Interlock

Do not install the interlock circuit, as detailed in the CALTRANS Specifications.

10. Cabinet Drawer

Equip each Model 334, 332A, and 336S cabinet with an aluminum storage compartment mounted in the rack assembly with the approximate following dimensions: 16 inches (400 mm) wide, 14 inches (350 mm) long, and 1.75 inches (44 mm) deep.

Mount this compartment directly under the Type 2070 controller. Provide a drawer with telescoping drawer guides to allow full extension from the rack assembly.

When extended, the storage compartment opens to provide storage space for cabinet documentation and other miscellaneous items.

Ensure that the storage compartment be of adequate construction to support a weight of 25 pounds (12 kg) when extended.

Provide a top for the storage compartment that has a non-slip plastic laminate attached, which covers a minimum of 90% of the surface area of the top.

11. Auxiliary Equipment Shelf

Provide a “shelf” in each cabinet that provides a location to mount Fiber modem, dialup modem and/or Field hardened switch. Provide shelf in location that allows easy access to AC power outlets and communications links (telephone, interconnect). Locate shelf so as not block access to other equipment or modules including Battery Backup System.

12. Power Strip

Equip each cabinet with a metal power strip (minimum of 4 outlets) to support AC power for external communications devices in cabinet. Provide metal strip that is mounted vertically on the rear rail. Ensure that the power strip may be used by block power supplies such that the block power supply does not block other outlets. Attach power strip to a permanent location that is easily accessible to devices in the rear of the cabinet. Provide hard wire connection to the Cabinet AC power, controlled by a 15 amp GFI breaker. Do not use plug in power strips.

13. Surge Protection

Equip each cabinet with devices to protect the control equipment from surges and over voltages.

Design the surge protector panels to allow for adequate space for a wire connection and surge protector replacement without the removal of terminal blocks or panels. Provide surge protectors for the input sections as detailed below and as shown in the Input Terminal and Surge Arrestor Detail.

Supply surge protectors that meet the following Specifications.

a. AC Service Input

- Include a surge protection unit for each cabinet on the AC service input that meets or exceeds the following requirements: Provide a hybrid type power line surge protection device on the cabinet service panel..

Install the protector between the applied line voltage and earth ground. Use a surge protector capable of reducing the effect of lightning transient voltages applied to the AC line that conforms to the following:

Peak surge current for an 8 x 20 μ s waveform:	20,000A for 20 occurrences
Clamp voltage @ 20,000A:	280V max
Maximum continuous operating current:	@ 120V / 60 Hz 10A
Series Inductance:	AC Line/AC Neutral - 200 micro henries
Response time:	Voltage never exceeds 280V during surge

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Spike suppression for +/- 700 V spike: +/- 40 V deviation from sine wave at all phases angles between 0 and 180 degrees.

- Provide a protector that is modular and uses a 12 pin Beau connector with the following terminals:
 - Main Line (AC line first stage terminal)
 - Main Neutral (AC neutral input terminal)
 - Equipment Line In (AC line second stage input terminal, 10A)
 - Equipment Line Out (AC line second stage output terminal, 10A)
 - Equipment neutral out (neutral terminal to protected equipment)
 - GND (Earth connection)
- Supply a protector that is epoxy encapsulated in a flame-retardant material.
- Configure the Equipment Line Out to provide power to the Type 2070 and to the 24 V power supply.

b. AC+ Interconnect Cable Inputs

Use a surge protection device to protect each AC interconnect line as it enters the cabinet with a surge protection device that meets or exceeds the following requirements:

- 3-electrode gas tube type of surge arrester
- Striking voltage of 300-500 V DC with a minimum holder over voltage of 155V DC
- A three terminal device, one of which is connected to ground, the other two are connected across each input respectively
- The units must meet the following minimum requirements:

Impulse breakdown:	Less than 100V in less than 1.1 μ s at 10 kV/ μ s
Impulse breakdown balance:	0.01 microsecond (or less) difference at 10 kV/ μ s impulse
Energy application:	Withstands 20A AC for one (1) second applied ten (10) times at three (3) minute intervals on either section
Current rating:	10,000A (8 x 20 μ s impulse)
Capacitance:	6 pF, line to ground

c. Inductive Loop Detector Inputs

Provide surge arrestors in the cabinet as shown in Table 925-5, Table 925-7 or Table 925-9 for the applicable cabinet. Protect each inductive loop detector channel input by an external surge protection device that meets or exceeds the following requirements:

- A three-terminal device, two (2) of which are connected across the signal inputs of the detector with the third connected to the chassis ground to protect against common mode damage.
- Instantly clamps differential mode surges (induced voltage across the loop detector input terminals) via a semiconductor array. The array appears as a low capacitance to the detector.
- Clamps common mode surges (induced voltage between the loop leads and ground) via solid state clamping devices.
- Withstand 25-100A surge current occurrences of a 10 x 700 μ s waveform.
- Have the following clamp characteristics:
 - Maximum break over voltage: 170 V
 - Maximum on-stage clamping voltage: 3V
 - Response Time: <5 ns
 - Off-stage leakage current: <10 μ A
 - Capacitance: less than 220 pf
- Ensure that the unit also meets the following minimum requirements:
 - Peak surge current: 6 times
 - Differential mode: 400 A (8 x 20 ms)
 - Common mode: 1,000 A (8 x 20 ms)

- Estimated occurrences: 500 @ 200 A
- Response time: 40 ns
- Input capacitance: 35 pF typical
- Temperature: -40° F to +185° F (-40° C to 85° C)
- Mounting: No. 10-32 x 3/8-inch (No. 5 x 10 mm) bolt
- Clamp voltage
 - @400 A diff. Mode: 30 V max.
 - @1,000 A comm. Mode: 30 V max.

d. Signal Load Switches (Switchpacks)

Provide the output of all switchpacks in all output files and output/PDAs with metal oxide varistors (MOV) tied from the AC positive field terminal to the chassis ground to protect switchpacks from surges on the AC output lines

Ensure that these MOVs meet or exceed these requirements:

- Steady state sinusoidal voltage (RMS) rating at 50 to 60 Hz of at least 150 V at 77 °F (25 °C)
- Steady state applied DC voltage rating of at least 200 V at 77 °F (25 °C)
- Transient energy rating is of at least 80 J for a single impulse of 10/1,000 μ s current waveform at 77 °F (25 °C)
- Peak current rating of 6,500 A for a single impulse of 8/20 μ s waveform with the rated continuous voltage applied
- Varistor voltage of at least 212 V at 1.0mA of DC current applied for the duration of 20 μ s to 5s
- Clamping voltage of at least 395 V with an applied 8/20 μ s impulse of 100 A
- Typical capacitance at a frequency of 0.1 to 1.0 MHz of 1600 pF
- Two-terminal device, one of which is connected to the AC output of the signal load switch on the output file terminals (backside of the field terminals) with the other connected to AC neutral

e. Communication Inputs

Protect low voltage communications input as it enters the cabinet with a solid-state surge protection unit that meets or exceeds these requirements:

- Dual pair (4-wire) module with a printed circuit board connector, double sided and gold plated for reliability
- Ability to mate with and be installed in a 10-circuit Buchanan connector Part Number PCB1B10S or Tyco Part Number 2-1437410-3 or equivalent
- Usable as two independent signal pairs
- The data circuits pass through the protection in a serial fashion
- C2 connector of the 2070 controller that terminates on the line side of the unit
- Communication field wires for this local side that terminate on the line side of the unit
- Ground terminals connected to power ground
- Ensure that the unit meets the following minimum requirements:

Peak surge current:	10 kA (8 x 20 μ s wave shape) 500A (10 x 700 μ s wave shape)
Occurrences @ peak:	50 typical
Response time:	<1ns
Voltage Clamp:	8V line to line
Series Resistance:	24 Ω total
Temperature	-40 °F (-40 °C) to +185 °F (85 °F)
Primary protector:	3 element gas tube 5kA, (8 x 20 μ s wave shape), per side
Secondary protector:	Silicon avalanche, 1.5 kW minimum

f. Low Voltage DC Inputs

Provide an external surge protection device for each low voltage DC input channel which meets the same requirements as the communication inputs with the following exception of the Voltage clamp, which shall be 30 V line-to-line.

14. Type 2010 Signal Monitors:

a. Introduction

This Specification sets forth the minimum requirements for a rack-mountable, sixteen channel, solid-state 2010 Signal Monitor for Traffic Cabinet Assembly. Ensure that as a minimum, the Signal Monitor complies with all Specifications outlined in Chapter 3 Section 6 of the *California TEES*, August 2002. Where differences occur, this Specification governs. Ensure that the manufacturer of the unit is listed on the current California Department of Transportation (CALTRANS) Qualified Products List (QPL) for signal monitors.

Provide a Signal Monitor that is capable of monitoring sixteen channels consisting of a Green input, a Yellow input, and a Red input for each channel. Ensure that the unit also includes the enhanced monitoring functions described in [Subsection 925.2.04.A.15.b](#), diagnostic display functions described in [Subsection 925.2.04.A.15.c](#), event logging functions described in [Subsection 925.2.04.A.15.d](#), communications functions described in [Subsection 925.2.04.A.15.e](#), and hardware functions described in [Subsection 925.2.04.A.15.f](#).

b. Monitor Functions

Except for Conflict faults, compute all fault timing for each channel individually.

1) Conflict Monitoring

Ensure that the Signal Monitor is able to detect the presence of conflicting green or yellow signal voltages on the AC field terminals between two or more non-compatible channels. A Conflict fault (CONFLICT) shall be a latching fault.

2) Conflict Recognition Time

Ensure the Signal Monitor shall trigger when voltages on any conflicting channels are present for more than 500 ms. Ensure that the Signal Monitor does not trigger when voltages on any conflicting channels are present for less than 200 ms. Conflicting signals sensed for more than 200 ms and less than 500 ms may or may not trigger the unit.

3) 24VDC Monitoring VDC

Ensure that the Signal Monitor is able to detect that the cabinet +24 Vdc supply has fallen below 18 Vdc. A 24VDC failure (VDC FAIL) shall be a latching fault.

4) 24VDC Recognition Time

Ensure that the Signal Monitor shall trigger when the voltage on the +24V input is below 18 Vdc for more than 500 ms. Ensure that the Signal Monitor does not trigger when the voltage on the +24V input is below 18 Vdc for less than 200 ms. A voltage level of +22 Vdc will be required to prevent the unit from triggering.

5) Controller Watchdog Monitoring

Ensure that the Signal Monitor triggers when the Watchdog input does not toggle within the programmed time period (WDT ERROR). Ensure that the unit remains latched in the fault state until reset by the Reset button, an External Reset input command, or AC Line voltage restoring from an AC Line Brownout event (see 2.4). Ensure that a reset resulting from an AC Line Brownout event does not clear the WDT ERROR LED.

a) Controller Watchdog Latch Option

Ensure a programming option sets the Watchdog monitoring function to a latching mode and that only a reset from the Reset button or External Reset input can clear a Watchdog fault. An AC Line brownout condition will not reset the fault.

b) Controller Watchdog Recognition Time

Ensure a programming option sets the maximum Watchdog recognition time to: 1000 + or - 100 ms; or 1500 + or - 100 ms.

c) Controller Watchdog Enable Switch

Provide an internal switch to disable the Watchdog monitoring function. Mount the switch on the PCB and be clearly label "WD ENABLE - ON...OFF". Ensure that placement of the switch in the OFF position causes monitoring of the Watchdog to be inhibited.

- d) WDT ERROR LED Control
 - Ensure that the WDT ERROR LED illuminates when the unit has been triggered by a Watchdog fault. Ensure that it can only be cleared by a reset command from the front panel Reset switch or External Reset input. If the Watchdog monitoring function is inhibited due to the Watchdog Enable switch, the WDT ERROR LED shall flash at a 0.5 Hz rate.
- 6) AC Line Monitoring
 - a) AC Line Brownout Recognition
 - Ensure that the Signal Monitor is able to detect that the AC Line has fallen below $98 + \text{ or } - 2 \text{ Vac}$ for greater than $400 + \text{ or } - 50 \text{ ms}$. This shall force the output Relay to the de-energized "fault" state, enable the Stop-Time output, and cause the AC POWER LED to flash at a 2 Hz rate. Ensure that the unit maintains this state until the AC Line voltage rises above $103 + \text{ or } - 2 \text{ Vac}$ for greater than $400 + \text{ or } - 50 \text{ ms}$. Provide a jumper option which will change the AC Brownout dropout level to $92 + \text{ or } - 2 \text{ Vac}$ and the restore level to $98 + \text{ or } - 2 \text{ Vac}$.
 - b) AC Line Power-up and Brownout Delay Time
 - When the AC Line is greater than $103 + \text{ or } - 2 \text{ volts}$ after power-up or Brownout restore, ensure that the Signal Monitor holds the Output Relay in the de-energized "fault" state and enable the Stop-Time output, for a period of not less than $6.0 + \text{ or } - 0.5 \text{ seconds}$ and not greater than $10.0 + \text{ or } - 0.5 \text{ seconds}$. Ensure that this flash interval is terminated after at least $6.0 + \text{ or } - 0.5 \text{ seconds}$ if the Signal Monitor has detected at least five transitions of the Watchdog input. If the Signal Monitor does not detect five transitions of the Watchdog input before $10.0 + \text{ or } - 0.5 \text{ seconds}$, ensure that the Signal Monitor goes to the fault state. During this interval, ensure that the AC POWER LED flashes at a 4 Hz rate.
- 7) Red Fail Monitoring
 - Ensure that the Signal Monitor is able to detect the absence of an active voltage on the green and yellow and red field signal inputs of a channel. Red Fail fault (RED FAIL) shall be a latching fault. Ensure that the Red Fail monitoring function is enabled for all channels except when the Red Enable input is not active, or pin #EE is active, or Special Function #1 input is active, or Special Function #2 input is active.
 - a) Red Fail Recognition Time
 - Ensure the Signal Monitor triggers when an active voltage on one of the three inputs of a channel are absent for more than 1500 ms. Ensure that the Signal Monitor does not trigger when an active voltage on one of the three inputs of a channel are absent for less than 1200 ms. Channels without proper voltages sensed for more than 1200 ms and less than 1500 ms may or may not trigger the unit. Provide an option switch (RF 2010) which will change the fault recognition time to between 700 ms and 1000 ms.
 - b) Red Interface Cable Fault
 - Ensure a programming option is provided such that operating without the Red Interface cable installed shall cause the Signal Monitor to enter the fault mode causing the Output relay contacts to close and enabling the Stop-Time output to the controller. To indicate this fault mode, ensure that the Red Fail indicator is illuminated with all fault channel indicators Off.
 - Ensure that any Red Fail preemption control to the monitor uses the Special Function inputs #1 or #2.
- 8) Dual Indication Monitoring
 - Ensure that the Signal Monitor is able to detect the presence of active voltage on the green and yellow, green and red, or yellow and red field signal inputs of a channel. GYR Dual Indication fault (DUAL IND) shall be a latching fault. Ensure this function is enabled on a per channel basis using dip switches mounted on the PCB labeled "CH1" through "CH16". Ensure that the GYR Dual Indication monitoring function is enabled for all selected channels except when the Red Enable input is not active or pin #EE is active.
 - a) GY Dual Indication Monitoring
 - Ensure that the Signal Monitor is able to detect the presence of active voltage on the green and yellow field signal inputs of a channel. GY Dual Indication fault (DUAL IND) shall be a latching fault. Enable this function with a dip switch on the PCB labeled "GY ENABLE". When the switch is in the ON position, monitor all channels for simultaneous active green and yellow inputs on a channel. When selected by the GY ENABLE switch, ensure that the GY Dual Indication monitoring function is disabled when pin #EE is active.

- b) Dual Indication Recognition Time
 - Ensure that the Signal Monitor triggers when multiple inputs are active on a channel for more than 500 ms. Ensure that the Signal Monitor does not trigger when multiple inputs are active on a channel for less than 250 ms. Channels with multiple voltages active for more than 250 ms and less than 500 ms may or may not trigger the unit.
- 9) Clearance (Short or Absent Yellow) Monitoring
 - Ensure that the Signal Monitor is able to detect that a channel has not provided an adequate Yellow Clearance interval during a green to yellow to red sequence. A Sequence failure (SEQUENCE) shall be a latching fault. Ensure that this function is enabled on a per channel basis using dip switches mounted on the PCB labeled "CH1" through "CH16". Ensure that the Sequence monitoring function is enabled for all selected channels except when the Red Enable input is not active or pin #EE is active.
- 10) Clearance Recognition Time
 - Ensure that the Yellow Clearance interval is 2.7 seconds
- 11) Flickering Indication Detection
 - Ensure that the Signal Monitor provides a method of detecting Conflict, Red Fail, and Dual Indication faults that result from intermittent or flickering field signal inputs that may not meet the duration requirements but continue to flicker for an extended period of time. These flickering indications shall result in a latching fault with an indication illuminated along with the resulting Conflict, Red Fail, or Dual Indication indicator. Provide an option switch to disable this option.
- 12) Configuration Change Monitoring
 - On power-up, reset, and periodically during operation, ensure that the Signal Monitor compares the current configuration settings with the previously stored value and if the settings have changed, the Signal Monitor automatically logs the new setting. Ensure that these settings include the permissive diode matrix, all switches, all jumpers, and the Watchdog Enable switch.
 - Provide a programming option such that any change in the configuration parameters will cause the Signal Monitor to enter the fault mode causing the Output relay contacts to close and enabling the Stop-Time output to the controller. To indicate this fault mode ensure that the PCA indicator will flash at a 4 Hz rate. Depressing the Reset button for 5 full seconds is required to clear this fault and log the new configuration parameters.
 - If the programming option is not selected, ensure that the unit does not set the fault mode but will still log the configuration change.
- 13) Program Card Ajar
 - Ensure that when the Programming Card is removed or not seated properly, the Signal Monitor forces the Output Relay to the de-energized "fault" state, enable the Stop-Time output, and illuminate the PCA LED. A reset command from the front panel Reset switch or External Reset input is required once the Program Card is in place.
- 14) Exit Flash
 - When the Signal Monitor exits the flash state (Output relay de-energized) as a result of a Reset command or AC Line brownout restore, ensure that the Stop Time output goes to the inactive state 250 + OR - 50 ms before the Output relay transfers to the energized state. This transition will provide an early indication to the Controller Unit that the cabinet will transfer from flash to signal operation.
- c. Display Functions
 - Ensure that it is possible to view the active channels for each individual color (GYR) during operation and when latched in a fault state. When the Signal Monitor is latched in a fault state ensure that it is also be possible to view the active channels for each individual color and fault status for each channel for the current fault and the two previous faults.
 - 1) Previous Fault GYR Display
 - When the Signal Monitor has been triggered by a fault the channel status display will alternate between the channels which were involved in the fault (fault status) for 2 seconds, and the field signals active at the time of the fault for 6 seconds. The channels involved in the fault will flash their respective Green, Yellow, and Red indicators simultaneously at a 4 Hz rate for the 2 second interval.
 - The two previous faults may also be displayed individually. This status is not reset by an AC Line power interruption. To enter this display mode remove the Program Card. The sequence is as follows:

Reset	Event	PCA LED	Fault Status LEDs	Channel Status LEDs
---	#1	Single flash	Current Fault Status (newest)	Current Field status
#1	#2	Double flash	Event #2 Fault Status	Event #2 Field status
#2	#3	Triple flash	Event #3 Fault Status (oldest)	Event #3 Field status
(repeats back to top)				

d. Event Logging Functions

Ensure that the Signal Monitor is capable of storing in non-volatile memory a minimum of 100 events. Mark each event with the time and date of the event. These events consist of fault events, AC Line events, reset events, and configuration change events. Provide a graphical means of displaying the signal states of all field inputs for 30 seconds prior to a fault trigger event. Provide the capability to assign a four-digit identification number to the unit shall be provided. Upload the event logs to a PC using the serial port of the Signal Monitor and software provided by the manufacturer.

Ensure each event log report contains the following information:

- Monitor ID#: a four digit (0000-9999) ID number assigned to the monitor.
- Time and Date: time and date of occurrence.
- Event Number: identifies the record number in the log. Event #1 is the most recent event.

1) Monitor Status Report (CS)

Ensure the Current Status report contains the following information:

Fault Type: the fault type description.

Field Status: the current GYR field status and field RMS voltages if the monitor is not in the fault state, or the latched field status and field RMS voltages and fault channel status at the time of the fault.

Cabinet Temperature: the current temperature if the monitor is not in the fault state, or the latched temperature at the time of the fault.

AC Line Voltage: the current AC Line voltage if the monitor is not in the fault state, or the AC Line voltage at the time of the fault.

Control Input Status: the current state and RMS voltages of the Red Enable input, EE input, and Special Function #1 and #2 inputs if the monitor is not in the fault state, or the status latched at the time of the fault.

2) Previous Fault Log (PF)

Ensure the Previous Fault log contains the following information:

Fault Type: the fault type description.

Field Status: the latched field status with RMS voltages, and fault channel status at the time of the fault.

Cabinet Temperature: the latched temperature at the time of the fault.

AC Line Voltage: the AC Line voltage at the time of the fault.

Control Input Status: the latched state of the Red Enable input, EE input, and Special Function #1 and #2 inputs at the time of the fault.

3) AC Line Event Log (AC)

The AC Line log shall contain the following information:

Event Type: describes the type of AC Line event that occurred.

- Power-up—AC on, monitor performed a cold start
- Interrupt—AC Line < Brownout level
- Restore—AC restored from brown-out or interruption (AC Off), no cold start

AC Line Voltage: the AC Line voltage at the time of the event.

4) Monitor Reset Log (MR)

Ensure the Monitor Reset log contains the following information:

The monitor was reset from a fault by the front panel Reset button or External Reset input.

5) Configuration Change Log (CF)

Ensure the Configuration Change log contains the following information:

- a) Program Card Matrix: the permissive programming for each channel.
 - b) Yellow Disable Jumpers: the Yellow Disable programming for each channel.
 - c) Dual/Sequence Switches: the switch programming for each channel.
 - d) Option Switches: RF 2010, RP Disable, GY Enable, SF1 Polarity, Sequence Timing, Minimum Flash Enable, Configuration Fault Enable, Red Cable Fault enable, AC Brownout timing.
 - e) Watchdog Programming: Watchdog Enable, Watchdog Latch, and Watchdog timing.
 - f) Configuration CRC: A unique CRC value which is based on the configuration of items #a through #e above.

Indicate on the log, which items have been changed since the last log entry.
- 6) Signal Sequence Log
Provide a log that graphically displays all field signal states for up to 30 seconds prior to the current fault trigger event. Ensure that the resolution of the display is at least 50 milliseconds.
- e. Communications Functions
- 1) Controller Unit Communications
Ensure that the Signal Monitor is compatible with the protocol of the current GDOT licensed firmware for 2070 controllers and Central System Control. Ensure the 2010 Conflict Monitor supplied is able to communicate via a serial link to the 2010 Controller and then to a Central System using the current licensed GDOT Central System Software for reporting, configuring and logging.
 - 2) Personal Computer Communications
Have the manufacturer provide software to access the Signal Monitor status and event logs described in [Subsection 925.2.04.A.15.d](#). Ensure this software operates with current version of Microsoft Windows or Windows XP™
- f. Hardware
- 1) Red Monitoring
 - a) Red Field Inputs
Ensure that the Signal Monitor is capable of monitoring sixteen Red field signals. Ensure that a Red input is sensed active when the input voltage exceeds 70 Vrms. Ensure that a Red input is sensed not active when the input voltage is less than 50 Vrms. A Red input may or may not be sensed active when the input voltage is between 50 Vrms and 70 Vrms.
 - b) Red Enable Input
Ensure that the Red Enable input provides an AC input to the unit which enables Red Monitoring, Dual Indication Monitoring, and Sequence monitoring when the input is sensed active.
Ensure that the Red Enable input is sensed active when the input voltage exceeds 70 Vrms. Ensure that the Red Enable input is sensed not active when the input voltage is less than 50 Vrms. The Red Enable input may or may not be sensed active when the input voltage is between 50 Vrms and 70 Vrms.
 - c) Special Function Preemption Inputs
Ensure that the Special Function Preemption inputs #1 and #2 provide an AC input to the unit which disables only Red Fail Monitoring (Lack of Output) when either input is sensed active.
Ensure that a Special Function input is sensed active when the input voltage exceeds 70 Vrms. Ensure that a Special Function input is sensed not active when the input voltage is less than 50 Vrms. A Special Function input may or may not be sensed active when the input voltage is between 50 Vrms and 70 Vrms.
Use a PCB mounted switch to provide the option to invert the active status of the Special Function #1 input. When the switch is in the ON position, ensure that the Special Function #1 input is sensed not active when the input voltage exceeds 70 Vrms. Ensure that the Special Function #1 input is sensed active when the input voltage is less than 50 Vrms. The Special Function #1 input may or may not be sensed active when the input voltage is between 50 Vrms and 70 Vrms.
 - d) Red Interface Connector
This connector provides the required inputs for the unit to monitor the Red field signal outputs. Ensure the connector is a 20 pin connector that mates with the P20 Cable from the output file. Provide a high quality connector that is polarized to insure proper mating with the cable. Ensure Ejector latches are included to facilitate removal and prevent the cable from inadvertently disconnecting. Ensure the unit

shall function as a standard 210 Signal Monitor when the cable is disconnected. Use the pin assignments shown in Table 925-1.

Table 925 -1 Red Interface Connector			
Pin	Function	Pin	Function
1	Channel 15 Red	11	Channel 9 Red
2	Channel 16 Red	12	Channel 8 Red
3	Channel 14 Red	13	Channel 7 Red
4	Chassis Ground*	14	Channel 6 Red
5	Channel 13 Red	15	Channel 5 Red
6	Special Function #2	16	Channel 4 Red
7	Channel 12 Red	17	Channel 3 Red
8	Special Function #1	18	Channel 2 Red
9	Channel 10 Red	19	Channel 1 Red
10	Channel 11 Red	20	Red Enable

*A jumper option shall be provided to allow the connection of Pin #4 to be made with Chassis Ground.

2) Front Panel

Ensure the front panel is constructed of sheet aluminum with a minimum thickness of 0.090 in. (2.286 mm), and finished with an anodized coating. Ensure the model information shall be permanently displayed on the front surface.

a) Indicators

Ensure that all display indicators are mounted on the front panel of the Signal Monitor and are water clear, T-1 package, Super Bright type LEDs. Ensure that all fault LEDs are red except the AC POWER indicator which is green. Provide a separate Red, Yellow, and Green indicator for each channel. Label the indicators and provide the information as follows:

i. AC POWER

Ensure the AC Power indicator flashes at a rate of 2 Hz when the unit has detected a low voltage condition as described in [Subsection 925.2.04.A.15.b.10\).a](#). Ensure the AC POWER indicator flashes at a rate of 4 Hz during the minimum flash interval as described in [Subsection 925.2.04.A.15.b.10\).b](#). Ensure that the indicator illuminates when the AC Line voltage level is restored above the brownout level. Ensure the indicator extinguishes when the AC Line voltage is less than 80 Vac.

ii. VDC FAILED

Ensure the VDC FAILED indicator illuminates when a 24VDC fault condition is detected. This indicator remains extinguished if the monitor has not been triggered by a 24VDC fault.

iii. WDT ERROR

Ensure the WDT ERROR indicator illuminates when a controller Watchdog fault is detected. Ensure the WDT Error indicator flashes ON once every 2 seconds if the WD Enable switch on the monitor is placed in the OFF position to disable Watchdog monitoring, or the AC Line voltage is below the Watchdog disable level.

iv. CONFLICT

Ensure that the CONFLICT indicator illuminates when a conflicting signal fault is detected.

v. DIAGNOSTIC

Ensure the DIAGNOSTIC indicator illuminates when one of the following faults is detected: Internal Watchdog fault, Memory Test fault, or Internal power supply fault. This indicator is intended to inform the service technician of a monitor hardware or firmware failure.

vi. *RED FAIL*

Ensure the RED FAIL indicator illuminates when an absence of signal is detected on a channel(s). Ensure the RED FAIL indicator flashes ON once every two seconds if the RED ENABLE input is not active, or a Special Function input is active, or the EE input is active

vii. *DUAL IND.*

Ensure the Dual IND. indicator illuminates when a GY-Dual or GYR-Dual Indication fault is detected on a channel(s).

viii. *CLEARANCE*

Ensure the Sequence indicator illuminates when the minimum Yellow Clearance time has not been met on a channel(s).

ix. *PCA*

Ensure the PCA indicator illuminates if the Program Card is absent or not properly seated.

If the unit is in the Diagnostic Display mode, ensure the PCA indicator flashes ON (once, twice, or three times) to indicate the fault event number being displayed. See [Subsection 925.2.04.A.15.c](#).

x. *RP DETECT*

Ensure the RP DETECT indicator illuminates when the unit has detected a Conflict, Red Fail, or Dual Indication fault as a result of recurring pulse field inputs.

xi. *CHANNEL STATUS*

Ensure that during normal operation the 48 Channel Status indicators display all active signals (Red, Green, and Yellow).

In the fault mode, ensure that the Channel Status indicators display all signals active at the time of the fault for six seconds and then indicate the channels involved in the fault for 2 seconds.

b) Front Panel Control-Reset Button

i. *Provide a momentary SPST Control switch labeled RESET on the unit front panel to reset the monitor circuitry to a non-failed state. Position the switch on the front panel such that the switch can be operated while gripping the front panel handle. Ensure that a reset command issued from either the front panel button or External Reset input is a one-time reset input to prevent the unit from constant reset due to a switch failure or constant external input, and causes all LED indicators to illuminate for 300 ms.*

ii. *The Reset button also provides control of the Diagnostic Display mode. For a complete description of Diagnostic Display operation, see [Subsection 925.2.04.A.15.c](#).*

c) Serial Communications Connector

Use this connector to provide EIA-232 serial communications. Ensure that it is a high quality 9 pin metal shell D subminiature type with female contacts. Refer to Table 925-2 for Pin assignments.

Pin	Function
1	DCD*
2	TX DATA
3	RX DATA
4	DTR (Data Terminal Ready)
5	SIGNAL GROUND
6	DSR
7	DSR*
8	CTS*
9	NC

* Provide Jumper options to allow the connection of Pin #4 to be made with Pin #7, and the connection of Pin #8 to be made with Pin #1.

- 3) Electronics
 - a) RMS Voltage Sampling

Use high speed sampling techniques to determine the true RMS value of the AC field inputs. Sample each AC input at least 32 times per cycle. Ensure that the RMS voltage measurement is insensitive to phase, frequency, and waveform distortion.
 - b) Internal MPU Watchdog

Use a microprocessor for all timing and control functions. Verify continuing operation of the microprocessor by an independent monitor circuit, that forces the Output Relay to the de-energized "fault" state, enable the Stop-Time output, and illuminate the DIAGNOSTIC indicator if a pulse is not received from the microprocessor within 300 ms.

If the microprocessor should resume operation, ensure the Signal Monitor continues to operate. Ensure that this monitoring circuit is also configurable to latch in the fault state. Ensure the unit requires a power-up cycle to reset the circuit once it is triggered.
 - c) Sockets

In the interest of reliability, ensure that only the PROM memory device for the microprocessor firmware is socket mounted. Ensure that the PROM memory socket is a precision screw machine type socket with a gold contact finish providing a reliable gas tight seal. Low insertion force sockets or sockets with "wiper" type contacts are not acceptable.
 - d) Internal Power Supply

Use a built-in, high-efficiency switching power supply to generate all required internal voltages. Ensure that all supply voltages regulated. Failure of the internal power supply to provide proper operating voltages shall force the output Relay to the de-energized "fault" state, enable the Stop-Time output, and illuminate the DIAGNOSTIC indicator. Provide a user replaceable slow blow fuse for the AC Line input. Ensure the unit is operational over the AC Line voltage range of 75 Vac to 135 Vac.
 - e) EIA-232 Interface

Ensure the EIA-232 port interface electronics is electrically isolated from all monitor electronics except chassis ground.
 - f) Configuration Parameters

Select user-programmed configuration settings using PCB mounted switches or jumpers. Designs requiring a Personal Computer (PC) to program or verify the configuration parameters are not acceptable. Ensure that user-programmed configuration settings that are transferred to memory are stored in a programmable read-only memory (PROM or EEPROM). Designs using a battery to maintain configuration data are not acceptable.
 - g) Field Terminal Inputs

Ensure that all 120 Vac field terminal inputs provide an input impedance of 150K 50K ohms and be terminated with a discrete resistor having a power dissipation rating of 0.5 Watts or greater and a voltage rating exceeding 350 volts.
 - h) Component Specifications

Ensure that all electrical components used in the Signal Monitor are rated by the component manufacturer to operate beyond the full unit operating temperature range of -29 °F to 165 °F (-34 °C to +74 °C).
 - i) Printed Circuit Boards

Ensure that all printed circuit boards meet the requirements of the *California Traffic Signal Control Equipment Specifications*, January 1989, plus the following requirements to enhance reliability:

 - i. All plated-through holes and exposed circuit traces are plated with solder.
 - ii. Both sides of the printed circuit board are covered with a solder mask material.
 - iii. The circuit reference designation for all components and the polarity of all capacitors and diodes are clearly marked adjacent to the component. Ensure that Pin #1 for all integrated circuit packages is designated on both sides of all printed circuit boards.
 - iv. All electrical mating surfaces are gold plated.

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- v. *All printed circuit board assemblies are coated on both sides with a clear moisture-proof and fungus-proof sealant.*
- vi. *All components and wire harnesses are mounted to the PCB using plated holes. "Piggy back" connections or jumper wires are not acceptable.*

15. Model 208 Monitor Unit

Provide Model 208 Monitor Unit in accordance with CALTRANS TEES and the following. Provide monitor that is on the CALTRANS QPL and provides the pin assignment as shown in Table 925-3.

The Model 208 Monitor Unit shall reliably sense and cause a relay output contact (FAILED STATE) when monitoring the following:

- A Watchdog Timer (WDT) Timeout Condition
 - Cabinet +24 VDC Power Supply below specified threshold
- a. WDT Monitor Requirements
 - b. WDT Circuitry shall be provided to monitor a controller unit output line state routed to the monitor unit at its assigned pin. The WDT Circuitry shall sense any line state change and the time between the last change. No state change for 1.5 ± 0.1 seconds shall cause a FAILED state. The timer shall reset at each state change in a NON FAILED state.
 - 1) Only the Unit Reset or a WDT inactive due to the voltage sense shall reset the WDT from a FAILED state.
 - 2) A FAILED state caused by the WDT shall illuminate a front panel indicator light label "WDT ERROR". The indicator shall remain ON until Unit Reset Issuance.
 - 3) The WDT Circuitry shall sense the incoming VAC Line and when the voltage falls below 98 ± 2 VAC for 50 ± 17 ms shall inhibit the WDT Function. When the WDT Circuitry sensed the incoming VAC Line rise above 103 ± 2 VAC for 50 ± 2 ms the WDT shall become active. A hysteresis between the Voltage Inhibit and the Voltage Active Setting shall be a minimum of 3 Volts.
 - c. Power Supply Monitor Requirements
 - 1) The monitor unit shall sense the Cabinet +24 VDC Power Supply Output Voltage.
 - 2) Voltages sensed at +18 VDC or below for a duration of 500 ms or longer shall cause a FAILED state.
 - 3) Voltages sensed at +22 VDC or above shall NOT cause a FAILED state.
 - 4) Voltages sensed below +22 VDC for a duration of 200 ms or less shall NOT cause a FAILED state.
 - 5) All timing and voltages conditions other than those specified above may or may not cause a FAILED state.
 - 6) A FAILED state caused by sensing the power supply shall illuminate a front panel indicator light labeled "VDC FAILED". The indicator shall remain ON until Unit Reset.
 - 7) Only Unit Reset shall reset the power supply sense circuitry from a FAILED state.
 - d. FAILED State Output Circuits
 - 1) An electro-mechanical relay shall be provided to switch an output circuit during a FAILED state. The relay coil shall be energized in a NON FAILED State.
 - 2) The relay contacts shall be rated for a minimum of 3 amperes at 120 VAC and 100,000 operations. Contact opening /closing time shall be 30 ms or less.
 - e. Monitor Unit Reset
 - 1) A momentary SPST CONTROL switch labeled "RESET" shall be provided on the unit front panel to reset the monitor unit circuitry to a NON FAILED state. The switch shall be so positioned on the front panel that the switch can be operated while gripping the front panel handle.
 - 2) The unit shall be provided with provision to drive an external NE2H light through a 56K Ohm, ½ Watt Series resistor (resident on unit)
 - 3) The PDA Type 3 WDT Reset Input shall not be sensed by the unit
 - 4) The output relay CONTACT FOR FAILED STATE shall be OPEN.

Table 925-3 Pin Assignments For Model 208 Monitor Unit	
PIN	FUNCTION
1/44	DC Ground
2/43	WDT Ext. Reset
5/40	WDT IN
10/35	+24 VDC
15/30	AC-
17/28	Normally Open, Circ. #2
19/26	AC+
20/25	Normally Closed, Circ. #1
21/24	Circ. Common #1 & #2
22/23	WDT Lamp (External)
NOTE: Card connector keyed between pins 2 & 3, and pins 11 & 12.	

16. Model 242 DC Isolator

Provide Model 242 DC Isolators that are in accordance with the latest version of CALTRANS Specifications as referenced earlier in this section. Provide isolators that:

- Allow the 242 isolator input signal polarity to easily be inverted without the use of tools. Acceptable methods are removable jumpers or dip switches. Unacceptable methods are soldering or desoldering a diode or resistor.
- Output is OFF for input voltages greater than 12 volts;
- Output is ON for voltages of less than 8 volts that have a duration of at least 5 to 25 ms (optional 2-7 ms);
- Minimum output pulse width is 100 ms with a valid input (can be disabled);
- Output is optically isolated open collector NPN transistor;
- Capable of sinking 50 ma when on;
- Can register a new input within 25 ms of the old signal going away; and
- Output clamped on power up and down
- Compatible with 2070 controllers and latest version of CALTRANS TEES including errata

17. Model 200 Switchpack

Provide Model 200 Switchpacks that are in accordance with the latest version of CALTRANS Specifications as referenced earlier in this section.

18. Model 204 Flasher Unit

Provide Model 204 Flasher Units that are in accordance with the latest version of CALTRANS Specifications as referenced earlier in this section.

19. Flash Transfer Relay

Provide Flash Transfer Relays that are in accordance with the latest version of CALTRANS Specifications as referenced earlier in this section.

20. Cabinet Model 332A

[Table 925-5 Required Surge Arrestors for Model 332A Cabinet.](#)

Supply Model 332A (lower input panel) cabinets, with housing Type 1B, and all components as described in these Specifications.

Supply cabinets having two input files which conform to the CALTRANS Specifications and configured to accept two 2070 controllers in the top portion of the cabinet. Ensure the cabinet has two shelves provided for controller(s).

Configure the cabinet for dial up communications. Mount a two (2) circuit Buchanan connector on the right side panel (from rear door).

Mount a phone jack with a RJ11 connector above or to the right of the Buchanan terminal block.

Wire the phone jack to the Buchanan and to the Terminal Block (TB0) in accordance with [Figure 925-2](#).

A manual jack shall be installed inside the cabinet. The jack shall intermate with a three circuit 1/4 inch (6.35 mm) diameter phone plug. The tip and ring (middle) circuits of the jack shall be connected to the logic ground and the interval advance inputs of controller unit. When the manual hand cord is plugged into the jack and the pushbutton is pressed, logic ground shall be connected to the interval advance input of the controller unit.

A Manual ON- OFF Switch shall be provided on the police panel which grounds the Manual Control Enable (C1 Pin 53) input to the controller whenever the switch is in the ON position and advance input (C1 Pin 80).

A manual pushbutton with cord shall be provided. The cord shall have a minimum length of 6 feet (1.8 m). It shall have a 1/4 inch (6.35 mm) diameter, three circuit plug connected to one end and a manual pushbutton enclosed in a hand held enclosure at the other end. A complete cycle (push-release) of the manual pushbutton shall terminate the controller unit interval which is active except the vehicular yellow and all red clearance intervals. Cycling the push-button during the vehicular yellow or all red clearance intervals shall not terminate the timing of those intervals.

21. Cabinet Model 332A with Auxiliary Output File)

Ensure that this unit meets the requirements of [Subsection 925.2.04.A.20](#) above, except that the cabinet is configured with an Auxiliary Output File. Additionally, the field wiring terminals may be mounted on the rear of the input file.

22. Cabinet Model 336S (Base Mount)

This unit meets the CALTRANS Specification with the addition of approximately 6 additional inches (150 mm) of cabinet height exclusive of the "M" base adapter. Configure the internal component layout so that the additional space is available in the bottom area of the cabinet cage. Ensure that the field wiring input panels and surge protection conform to [Table 925-6 Model 336S Default Input File Assignment Detail](#) and [Table 925-7 Required Surge Arrestors for Model 336S Cabinet](#).

Ensure that the C1 connector harness is provided with pins for all 104 inputs and outputs from the controller.

A manual jack shall be installed on the police panel. The jack shall intermate with a three circuit 1/4 inch (6.35 mm) diameter phone plug. The tip and ring (middle) circuits of the jack shall be connected to the logic ground and the interval advance inputs of controller unit. When the manual hand cord is plugged into the jack and the pushbutton is pressed, logic ground shall be connected to the interval advance input of the controller unit.

A Manual ON- Off Switch shall be provided on the police panel which grounds the Manual Control Enable (C1 Pin 53) input to the controller whenever the switch is in the ON position

A manual pushbutton with cord shall be provided. The cord shall have a minimum length of 3 feet (0.9 m). It shall have a 1/4 inch (6.35 mm) diameter, three circuit plug connected to one end and a manual pushbutton enclosed in a hand held enclosure at the other end. A complete cycle (push-release) of the manual pushbutton shall terminate the controller unit interval which is active except the vehicular yellow and all red clearance intervals. Cycling the push-button during the vehicular yellow or all red clearance intervals shall not terminate the timing of those intervals.

23. Cabinet Model 336S (Pole Mount)

Ensure that this unit meets the requirements of [Subsection 925.2.04.A.22](#) above, except that the cabinet is configured for pole mounting as specified in the General Requirements for Type 170 Cabinet Assemblies.

24. Cabinet Model 336S (Base Mount with Auxiliary Output File)

Ensure that this unit meets the requirements of [Subsection 925.2.04.A.22](#) above, except that the cabinet is configured with an Auxiliary Output File. Additionally, the field wiring terminals may be mounted on the rear of the input file.

25. Cabinet Model 337

The Model 337 cabinet is a compact cabinet with an output capacity of four vehicle phases plus two pedestrian phases; the dimensions not to exceed 17 inches (425 mm) deep x 20 inches (500 mm) wide x 35 inches (875 mm) high and its shipping weight not to exceed 175 pounds (80 kg).

Supply the cabinet assembly with capacity for 11, two-channel slots in the input file.

Ensure that the pin assignments of the C1 connector are compatible with the 2070 controller as applicable according to the required number of input/outputs.

Ensure that the 337 cabinet uses standard Type 170 input and output file units.

Equip the cabinet with a C2 connector harness with field terminals protected with surge protectors for communication inputs as specified under communications inputs.

Ensure that the cabinet has two full-size doors to allow complete access from the front or back of the cabinet. Design the rack assembly to mount in CALTRANS standard rails to allow for a Model 204 flasher.

Provide a receptacle to accept the plug in power distribution assembly card guides and edge connectors for the input file card guides to support the conflict monitor, and load switches and flash transfer relays.

Due to the compact design of this cabinet assembly, the Department of Transportation may accept a non-standard type of power distribution assembly (PDA).

26. Cabinet Model 334 with Auxiliary Output File for Ramp Metering Operations

The Controller Cabinet shall comply with the CALTRANS Traffic Signal Equipment Specifications (1989), Model 334 Cabinet Specifications (Chapter 6). **DO NOT** use the February 1993 Amendments for Specifications for the Model 334C Cabinet. Do use the Specification Clarifications dated December 20, 1993.

Provide Cabinet configured as shown in Figure 925-1.

Provide Detector Test Switch Panel. Before providing cabinet submit Detector Switch Test panel design and mounting location for approval. Panel shall include one switch for each of the 13 detector inputs.

- a. The Detector Test Switch Panel shall be mounted in the cabinet on the rails. The panel shall be fabricated from brushed aluminum.
- b. Each switch will be labelled as to function. The label shall be silkcreened on the test panel and be at least ¼ inch in height.
- c. A three position switch shall be provided for each detector input. The switch shall function as follows:
 - Down (Momentary) - Call is placed into the controller on the appropriate input in parallel with field input
 - Up (Lock) – Call is placed into the controller on the appropriate input in parallel with field input.
 - Center (Lock)– Normal Operation field output of detector is connected to the controller unit.

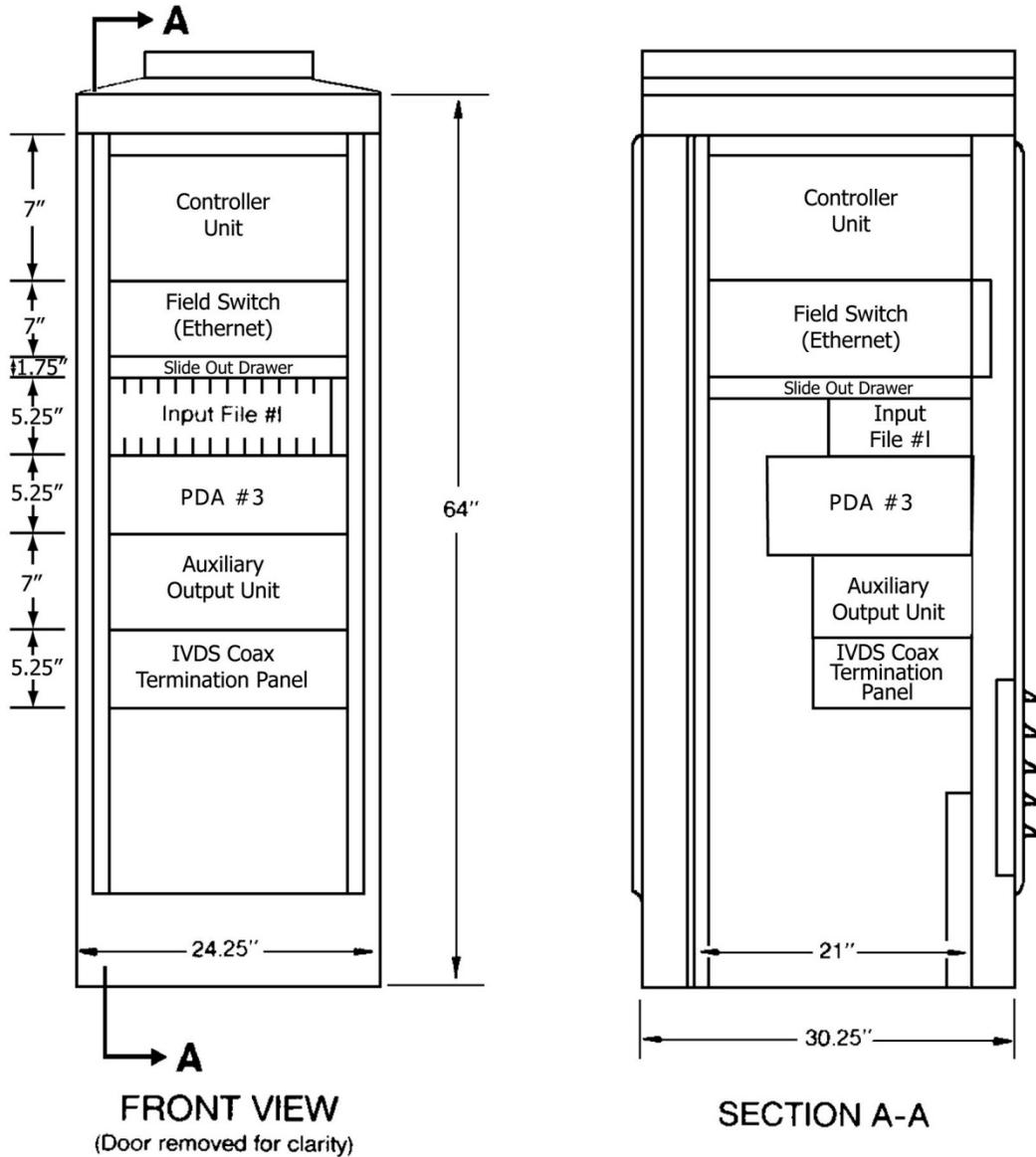


Figure 925-1 Typical 334 Cabinet Configuration

B. Fabrication

Refer to [Subsection 925.2.06.A.1](#) for controller cabinet minimum fabrication Specifications.

C. Acceptance

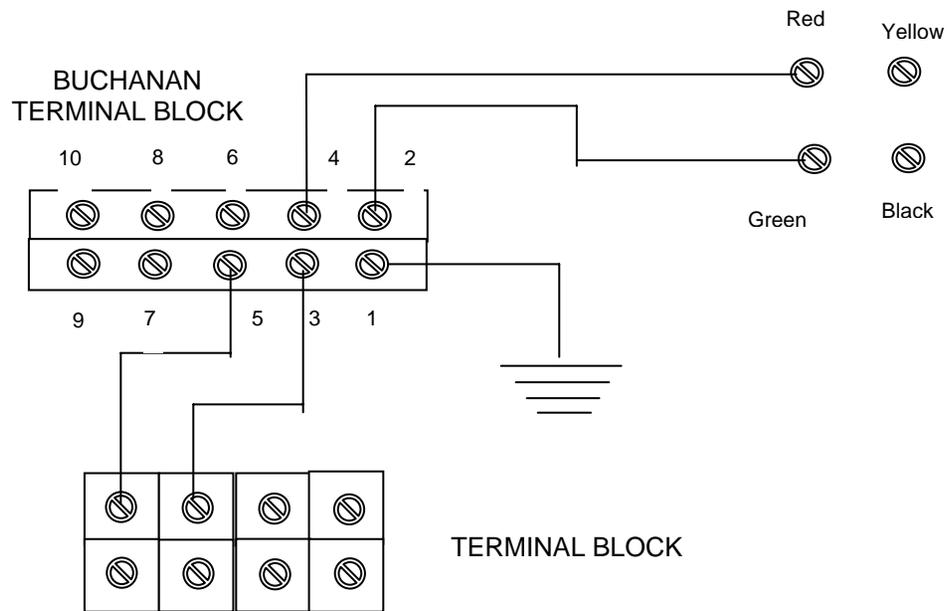
Refer to [Subsection 925.2.01.A](#) for compliance with CALTRANS QPL.

D. Materials Warranty

Refer [Subsection 925.2.01.D](#) for Materials Warranties.

Upper Input File (I)	Slot		1	2	3	4	5	6	7	8	9	10	11	12	13	14	
	Type		Det	Det	Det	Det	Det	Det	Det	Det	Det				DC	DC	DC
	Channel 1	C1 Pin	56	39	63	47	58	41	65	49	60		80	67	68	81	
		Function	Ph1	Ph2	Ph2	Ph2 CALL	Ph3	Ph4	Ph4	Ph4 CALL	Ph1		INT ADV	Ph2 PED	Ph6 PED	FLASH	
		Field Term	TB-2 1,2	TB-2 5,6	TB-2 9,10	TB-4 1,2	TB-4 5,6	TB-4 9,10	TB-6 1,2	TB-6 5,6	TB-6 9,10		NC	TB-8 4,6	TB-8 7,9	NC	
	Channel 2	C1 Pin	56	43	76	47	58	45	78	49	62		53	69	70	82	
		Function	Ph1	Ph2	Ph2	Ph2 CALL	Ph3	Ph4	Ph4	Ph4 CALL	Ph3		MCE	Ph4 PED	Ph8 PED	STOP TIME	
		Field Term	TB-2 3,4	TB-2 7,8	TB-2 11,12	TB-4 3,4	TB-4 7,8	TB-4 11,12	TB-6 3,4	TB-6 7,8	TB-6 11,12		NC	TB-8 5,6	TB-8 8,9	NC	
Lower Input File (J)	Slot		1	2	3	4	5	6	7	8	9	10	11	12	13	14	
	Type		Det	Det	Det	Det	Det	Det	Det	Det	Det				TBA	TBA	DC
	Channel 1	C1 Pin	55	40	64	48	57	42	66	50	59		54	71	72	51	
		Function	Ph5	Ph6	Ph6	Ph6 CALL	Ph7	Ph8	Ph8	Ph8 CALL	Ph5			EVA	EVB	R/R	
		Field Term	TB-3 1,2	TB-3 5,6	TB-3 9,10	TB-5 1,2	TB-5 5,6	TB-5 9,10	TB-7 1,2	TB-7 5,6	TB-7 9,10			TB-9 4,6	TB-9 7,9	TB-9 10,12	
	Channel 2	C1 Pin	55	44	77	48	57	46	79	50	61		75	73	74	52	
Function		Ph5	Ph6	Ph6	Ph6 CALL	Ph7	Ph8	Ph8	Ph8 CALL	Ph7			EVC	EVD			
Field Term		TB-3 3,4	TB-3 7,8	TB-3 11,12	TB-5 3,4	TB-5 7,8	TB-5 11,12	TB-7 3,4	TB-7 7,8	TB-7 11,12			TB-9 5,6	TB-9 8,9	TB-9 11,12		

Field Terminal Block	Terminals	Required Arrestor
TB-8	1-12	Section 925.2.04.A.13.f
TB-9	10-12	Section 925.2.04.A.13.f
TB-9	4-9	Terminal Block only Section 925.2.04.A.13.f
TB-2, TB-3, TB-4, TB-5, TB-6, TB-7	1-12	Section 925.2.04.A.13.c



Note: For a typical signal installation, the Model 332 cabinet is the design standard.

Figure 925-2—Wiring Diagram for Dial-up Communications

Slot		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Type		Det	Det	Det	Det	Det	Det	Det	Det	DC	TBA	TBA	DC	DC	DC
Channel 1	C1 Pin	56	39	58	41	55	40	57	42	51	71	72	67	68	81
	Function	Ph1	Ph2	Ph3	Ph4	Ph5	Ph6	Ph7	Ph8	SE1	EVA	EVB	Ph2 PED	Ph6 PED	FLASH
	Field Term	TB-7 1,2	TB-7 5,6	TB-7 9,10	TB-8 1,2	TB-8 5,6	TB-8 9,10	TB-9 1,2	TB-9 5,6	TB-9 1,2	TB-5 5,6	TB-5 9,10	TB-5 1,2	TB-4 5,6	NC
Channel 2	C1 Pin	47	43	49	45	48	44	50	46	52	73	74	69	70	82
	Function	Ph2 CALL	Ph2	Ph4 CALL	Ph4	Ph6 CALL	Ph6	Ph8 CALL	Ph8	R/R	EVC	EVD	Ph4 PED	Ph8 PED	STOP TIME
	Field Term	TB-7 3,4	TB-7 7,8	TB-7 11,12	TB-8 3,4	TB-8 7,8	TB-8 11,12	TB-9 3,4	TB-9 7,8	TB-9 3,4	TB-5 7,8	TB-5 11,12	TB-5 3,4	TB-4 7,8	NC

Field Terminal Block	Terminals	Required Arrestor
TB-4	1-12	Section 925.2.04.A.13.f
TB-5	1-4	Section 925.2.04.A.13.f
TB-5	5-12	Terminal Block only Section 925.2.04.A.13.f
TB-7, TB-8, TB-9	1-12	Section 925.2.04.A.13.c

Slot		1	2	3	4	5	6	7	8	9	10	11	12	13	14	
Type		Det	Det	Det	Det	Det	Det	Det	Det	Det	Det	Det	TBA	TBA	TBA	
Channel 1	C1 Pin	46	50	49	55	51	57	59	61	81	79	53	41	43	45	
	Function	L1 D1	L2 D2	L1 Q1	L3 Q3	L1 MLA	L2 MLA	L3 MLA	L4 MLA			L3 D3				
	Field Term	TB-2 1,2	TB-2 5,6	TB-2 9,10	TB-3 1,2	TB-3 5,6	TB-3 9,10	TB-4 1,2	TB-4 5,6	TB-4 9,10	TB-4 1,2	TB-5 5,6	TB-5 9,10	TB-5 1,2	TB-6 1,2	TB-6 5,6
Channel 2	C1 Pin	39	47	48	56	52	58	60	62	80	82	54	40	42	44	
	Function	L1 P1	L2 P2	L2 Q2		L1 MLB	L2 MLB	L3 MLB	L4 MLB			L3 P3				
	Field Term	TB-2 3,4	TB-2 7,8	TB-2 11,12	TB-3 3,4	TB-3 7,8	TB-3 11,12	TB-4 3,4	TB-4 7,8	TB-4 11,12	TB-4 3,4	TB-5 7,8	TB-5 11,12	TB-5 3,4	TB-6 3,4	TB-6 7,8

Table 925-9 Required Surge Arrestors for Model 334 Cabinet		
Field Terminal Block	Terminals	Required Arrestor
TB-2, TB-3, TB-4	1-12	Section 925.2.04.A.13.c
TB-5	1-4	Section 925.2.04.A.13.c

Table 925 - 10 Model 334 PDA Type 3 Output File															
	SP 1					SP 2					SP 3				
	C1 Pin	Out #	Conn	Func	Field Term	C1 Pin	Out #	Conn	Func	Field Term	C1 Pin	Out #	Conn	Func	Field Term
SP R	2	0	C6-1	Warn 1	T4-7	4	2	C6-3	Lane 1 R	T4-4	7	5	C6-6	Lane 2 R	T4-1
SP Y	37	34	C6-9		T4-8	5	3	C6-4	Lane 1 Y	T4-5	8	6	C6-7	Lane 2 Y	T4-2
SP G	3	1	C6-2	Warn 2	T4-9	6	4	C6-5	Lane 1 G	T4-6	9	7	C6-8	Lane 2 G	T4-3

Table 925 - 11 Model 334 Auxiliary Output File															
	SP 9					SP 10					SP 11				
	C1 Pin	Out #	Conn	Func	Field Term	C1 Pin	Out #	Conn	Func	Field Term	C1 Pin	Out #	Conn	Func	Field Term
SP R	97	53	C5-14	Lane 3 R	A124	94	50	C5-11	Not used	A121	91	48	C5-9	Not used	A114
SP Y	98	54	C5-15	Lane 3 Y	A125	95	51	C5-12	Not used	A122	101	37	C5-18	Not used	A115
SP G	99	55	C5-16	Lane 3 G	A126	96	52	C5-13	Not used	A123	93	49	C5-10	Not used	A116
	SP 12					SP 13					SP 14				
	C1 Pin	Out #	Conn	Func	Field Term	C1 Pin	Out #	Conn	Func	Field Term	C1 Pin	Out #	Conn	Func	Field Term
SP R	88	45	C5-6	Not used	A111	85	42	C5-3	Not used	A104	83	40	C5-1	Not used	A101
SP Y	89	46	C5-7	Not used	A112	86	43	C5-4	Not used	A105	100	36	C5-17	Not used	A102
SP G	90	47	C5-8	Not used	A113	87	44	C5-5	Not used	A106	84	41	C5-2	Not used	A103

925.2.05 Type ITS Cabinet Assemblies

A. Requirements

Ensure that the cabinet assembly meets the requirements of the CALTRANS Specifications as described in this document. In addition to the CALTRANS Specifications, ensure that the cabinet assembly conforms to the requirements listed below, which take precedence over conflicting CALTRANS Specifications.

1. Cabinet configuration:

Supply cabinets in accordance with the following information and table 925-12.

- a. Cabinet Traffic Signal Application - Series 340
 - 340 - 4 Door Cabinet with “P” Base Ground Mount
 - 342 - 2 Door Cabinet with “170” Base (332) Ground Mount
 - 346 - 2 Door Cabinet with ”170” Base (336S), Adaptor Mount
- b. Cabinet Traffic Management Application - Series 350
 - 354 - 2 Door Cabinet with “170” Base (332) Ground Mount
 - 356 - 2 Door Cabinet with “170” Base (336S) Adaptor Mount

Table 925-12 ITS Cabinet Configurations					
Items	ITS Cabinet Versions				
	340	342	346	354	356
	Qty	Qty	Qty	Qty	Qty
Housing # 1/ Cage #1		1		1	
Housing # 2/Cage #2			1		1
Housing #3/Two Cage #1	1				
“J” Panel Cage #1	4	2		2	
“J” Panel Cage #2			2		2
Service Panel Assembly with AC -/EG Bus	1	1	1	1	1
Raw/Clean AC power Assembly	1	1	1	1	1
Raw Clean AC power Extension	1				
AC Clean Module Assembly	1				
DC Power/Comm Assembly	2	1	1	1	1
DC Power/Comm Extension	2	1		1	1
Cabinet Shelf Assembly	2	1	1	1	1
Input Assembly	3	2	1	1	1
Six Pack Output Assembly	1			1	1
Fourteen Pack output Assembly	1	1	1		
PDA ITS Assembly	1	1	1	1	1
Control/Serial Bus harness	8	6	4	4	4
Serial Bus 3 Harness	3	1	1	1	1

Note: Input Assembly shall include a Model 218 SIU. Output Assembly shall include a Model 218 SIU, Model 214 AMU and Model 205 Transfer Relays. The PDA ITS (Traffic Signal Application) shall include two Model 204 Flasher Units, Model 212 CMU and two Model 216 Power Supply Units and attached harnesses. The PDA ITS (Traffic Management System Application) shall include Model 212 CMU and two Model 216 Power Supply Units and attached harnesses.

- c. Model 340 Cabinet:
 - Field termination panels
 - 9 – Flash Transfer Relays
 - 2 – Model 204 Flashers

Specific Equipment Layout and other cabinet devices determined on a project specific basis

- d. Model 342 Cabinet:
 - 1-Model 242 DC Isolator
 - 6- Flash Transfer Relays
 - 2-Model 204 Flashers
- e. Model 346 Cabinet
 - 1-Model 242 DC Isolator
 - 6-Flash Transfer Relays
 - 2-Model 204 Flasher
 - 1-"M" Base Adapter installed (Base Mount Cabinets Only)
 - 1-Aluminum Cover Plate for Cabinet Bottom (Pole Mount Cabinets Only)
- f. Model 354 Cabinet:

Specific Equipment Layout and additional cabinet equipment determined on a project specific basis.
- g. Model 356 Cabinet
 - Specific Equipment Layout and additional cabinet equipment determined on a project specific basis.
 - 1-"M" Base Adapter installed (Base Mount Cabinets Only)
 - 1-Aluminum Cover Plate for Cabinet Bottom (Pole Mount Cabinets Only)

Note: Include above components in cabinet at time of delivery.

Other auxiliary cabinet components such as controllers, load switches, etc. will be ordered as separate items.

2. Finish

Use cabinets that have a bare aluminum finish (see [Subsection 925.2.06.A.1](#) for controller-cabinet minimum fabrication specifications).

3. Locks

Equip the main cabinet door with locks that accept No. 2 Corbin keys. Provide two sets of keys with each cabinet. One set of keys is defined as one – No. 2 key and one - police panel key.

4. Power

Equip the cabinet assemblies with an ITS power distribution assembly to generate AC and DC power for the electronic components, except the DC power for the controller units.

5. Mounting

Equip the cabinets for pole or base mounting, as specified in the Plans.

a. Base Mount

Supply Model 346 and 356 cabinets, when specified as base mount, with a “M” base-mounting adapter installed.

b. Pole Mount

Supply Model 346 and 356 cabinets, when specified as pole mount, with two exterior pole mounting brackets that allow for mounting on steel, concrete, and timber poles.

Ensure that the bracket mounting holes are properly reinforced with metal plates of adequate size and strength, welded longitudinally across the inside depth of the cabinet.

Ensure that the exterior-mounting bracket is shipped installed on the cabinet housing. Additionally, provide an aluminum plate, which covers the bottom cabinet opening.

6. Cabinet Light

Include in each cabinet one fluorescent strip lighting fixture mounted inside the top front portion of the cabinet. Do not use a screw in type fluorescent lamp.

The fixture includes a cool white lamp, covered, and operated by a normal power factor, UL listed ballast.

Install a door-actuated switch to turn on the cabinet light when either door is opened.

7. Cabinet Interlock

Do not install the interlock circuit, as detailed in the CALTRANS Specifications.

8. Cabinet Drawer

Equip each Model 340, 342, 346, 352 and 356 cabinet with an aluminum storage compartment mounted in the rack assembly with the approximate following dimensions: 16 inches (400 mm) wide, 14 inches (350 mm) long, and 1.75 inches (44 mm) deep.

Mount this compartment directly under the Type 2070 controller. Provide a drawer with telescoping drawer guides to allow full extension from the rack assembly.

When extended, the storage compartment opens to provide storage space for cabinet documentation and other miscellaneous items.

Ensure that the storage compartment be of adequate construction to support a weight of 25 pounds (12 kg) when extended.

Provide a top for the storage compartment that has a non-slip plastic laminate attached, which covers a minimum of 90% of the surface area of the top.

9. Test Program

Supply each cabinet with a diagnostic test program, which verifies the operation of the cabinet. Ensure that the program can test cabinet wiring related to the output file, input file, and police panel and flash switches. In addition, ensure that the program can check the operation of the SIU, AMU and CMU by generating all possible conflicts, in sequence,

10. Surge Protection

Equip each cabinet with devices to protect the control equipment from surges and over voltages.

Design the surge protector panels to allow for adequate space for a wire connection and surge protector replacement without the removal of terminal blocks or panels. Provide surge protectors for the input sections as detailed below and as shown in the Input Terminal and Surge Arrestor Detail.

Supply surge protectors that meet the following Specifications.

a. AC Service Input

Include a surge protection unit for each cabinet on the AC service input that meets or exceeds the following requirements:

- Provide a hybrid type power line surge protection device on a service panel which plugs into a 12 pin Beau Connector which mounts on a service panel.

Install the protector between the applied line voltage and earth ground. Use a surge protector capable of reducing the effect of lightning transient voltages applied to the AC line that conforms to the following:

Peak surge current for an 8 x 20 μ s waveform:	20,000A for 20 occurrences
Clamp voltage @ 20,000A	280V max
Maximum continuous operating current:	@ 120V / 60 Hz 10A
Series Inductance:	AC Line/AC Neutral - 200 microhenries
Response time:	Voltage never exceeds 280V during surge
Spike suppression for +/- 700 V spike:	+/- 40 V deviation from sine wave at all phases angles between 0 and 180 degrees.

- Provide a protector with the following terminals:
 - Main Line (AC line first stage terminal)
 - Main Neutral (AC neutral input terminal)
 - Equipment Line In (AC line second stage input terminal, 10A)
 - Equipment Line Out (AC line second stage output terminal, 10A)
 - Equipment neutral out (neutral terminal to protected equipment)
 - GND (Earth connection)
- Supply a protector that is epoxy encapsulated in a flame-retardant material.
- Configure the Equipment Line Out to provide power to the Type 2070 and to the 24 V power supply.

b. Inductive Loop Detector Inputs

Protect each inductive loop detector channel input by an external surge protection device that meets or exceeds the following requirements:

- A three-terminal device, two (2) of which are connected across the signal inputs of the detector with the third connected to the chassis ground to protect against common mode damage.
- Instantly clamps differential mode surges (induced voltage across the loop detector input terminals) via a semiconductor array. The array appears as a low capacitance to the detector.
- Clamps common mode surges (induced voltage between the loop leads and ground) via solid state clamping devices.
- Withstand 25-100A surge current occurrences of a 10 x 700 μ s waveform.
- Have the following clamp characteristics:

Maximum break over voltage:	170 V
Maximum on-stage clamping voltage:	3V
Response Time:	<5 ns
Off-stage leakage current:	<10 μ A
Capacitance:	less than 220 pf
- Ensure that the unit also meets the following minimum requirements:

Peak surge current:	6 times
Differential mode:	400 A (8 x 20 ms)
Common mode:	1,000 A (8 x 20 ms)
Estimated occurrences:	500 @ 200 A
Response time:	40 ns
Input capacitance:	35 pF typical
Temperature:	-40° F to +185° F (-40° C to 85° C)
Mounting:	No. 10-32 x 3/8-inch (No. 5 x 10 mm) bolt

Clamp voltage	
@400 A diff. Mode:	30 V max.
@1,000 A comm. Mode:	30 V max.

c. Signal Load Switches (Switchpacks)

Provide the output of the switchpack in the output file with transient protection via the nine position transient protection device in the output file. Protect switchpacks from surges on the AC output lines.

Ensure that the transient protectors meet or exceed these requirements:

- Steady state sinusoidal voltage (RMS) rating at 50 to 60 Hz of at least 150 V at 77 °F (25 °C)
- Steady state applied DC voltage rating of at least 200 V at 77 °F (25 °C)
- Transient energy rating is of at least 80 J for a single impulse of 10/1,000 μ s current waveform at 77 °F (25 °C)
- Peak current rating of 6,500 A for a single impulse of 8/20 μ s waveform with the rated continuous voltage applied
- Varistor voltage of at least 212 V at 1.0mA of DC current applied for the duration of 20 μ s to 5s
- Clamping voltage of at least 395 V with an applied 8/20 μ s impulse of 100 A
- Typical capacitance at a frequency of 0.1 to 1.0 MHz of 1600 pF
- Two-terminal device, one of which is connected to the AC output of the signal load switch on the output file terminals (backside of the field terminals) with the other connected to AC neutral

d. Communication Inputs

Protect low voltage communications input as it enters the cabinet with a solid-state surge protection unit that meets or exceeds these requirements:

- Dual pair (4-wire) module with a printed circuit board connector, double sided and gold plated for reliability
- Ability to mate with and be installed in a 10-circuit Buchanan connector Part Number PCBIB10S or Tyco Part Number 2-1437410-3 or equivalent
- Usable as two independent signal pairs
- The data circuits pass through the protection in a serial fashion
- C2 connector of the 2070 controller that terminates on the line side of the unit
- Communication field wires for this local side that terminate on the line side of the unit
- Ground terminals connected to power ground
- Ensure that the unit meets the following minimum requirements:

Peak surge current:	10 kA (8 x 20 μ s wave shape)
	500A (10 x 700 μ s wave shape)
Occurrences @ peak:	50 typical
Response time:	<1ns
Voltage Clamp:	8V line to line
Series Resistance:	24 Ω total
Temperature	-40 °F (-40 °C) to +185 °F (85 °F)
Primary protector:	3 element gas tube 5kA, (8 x 20 μ s wave shape), per side
Secondary protector:	Silicon avalanche, 1.5 kW minimum

e. Low Voltage DC Inputs

Provide an external surge protection device for each low voltage DC input channel which meets the same requirements as the communication inputs with the following exception of the Voltage clamp, which shall be 30 V line-to-line.

11. Type 212 ITS Cabinet Monitor Unit

a. Introduction

Supply each cabinet with Type 212 ITS Cabinet Monitor Unit (CMU). Ensure the Type 212 CMU meets the CALTRANS TEES Specifications and functions as a unit with the a Type 214 Auxiliary Monitor Unit to provide the following monitoring functions: Cabinet Power Supplies,; Conflicting Channel Monitor, Serial Bus1 and 3 Error; Message 62; Diagnostic Error; Multiple Channel Inputs; Lack of Signal Inputs; Yellow Clearance; Yellow plus Red Clearance; Police and Power Distribution Switch Monitor; door Switches and Main Contactor Status; Circuit Breakers; Flash Unit Output Status; and AC Line Level Sense. Ensure the Unit supplied is listed on the most recent California Department of Transportation Qualified Products List (QPL).

b. Configuration

Supply Type 212 CMU capable of monitoring up to 28 physical load switch channels (RYG) plus 4 virtual channels for a total of 32 channels.

c. Programming

Ensure complete programming of the Type 212 CMU is by an interchangeable Datakey nonvolatile memory device. The Datakey shall store all of the configuration parameters. Ensure the programming of the datakey can easily be accomplished by a PC and provide datakey and programming device with the delivery of the first unit ordered. Orders of multiple ITS cabinets require delivery or 1 programming device with PC software for every 10 cabinets.

d. Logging

Ensure the Type 212 CMU maintains a non volatile event log recording. The complete intersection status as well as previous fault events, AC Line events, configuration changes, monitor resets, cabinet temperature and true RMS voltages for all field inputs. A real time clock time shall stamp each log event with the time and date.

Ensure a Signal Sequence History Log is stored in nonvolatile memory. The information stored in the signal sequence log shall provide graphic displays of up to 30 seconds of signal status prior to the fault trigger event with 50 ms resolution.

The Type 212 CMU shall be provided with PC Software that allows a review of status, event log review and archival.

12. Type 214 ITS Auxiliary Monitor Unit

a. Introduction

Supply each ITS cabinet output assembly with a Type 214 ITS Auxiliary Monitor Unit (AMU). Ensure the Type 214 CMU meets the CALTRANS TEES Specifications and functions with the a Type 212 Cabinet Monitor Unit to provide cabinet monitoring functions to perform the following monitoring functions: Cabinet Power Supplies, Conflicting Channel Monitor, Serial Bus 1 and 3 Error; Message 62; Diagnostic Error; Multiple Channel Inputs; Lack of Signal Inputs; Yellow Clearance; Yellow plus Red Clearance; Police and Power Distribution Switch Monitor; door Switches and Main Contactor Status; Circuit Breakers; Flash Unit Output Status; and AC Line Level Sense. Ensure the Unit supplied is listed on the most recent California Department of Transportation Qualified Products List (QPL). The Type 214 AMU shall provide the field signal sensing.

b. Current Monitoring

Supply Type 214 AMU capable of operating in a 14 channel mode or a 6 channel mode. Ensure the address select is correct for the output assembly in which the Model 214 AMU is installed.

c. Diagnostics

Ensure the Type 214 AMU has self diagnostic tests that execute continuously to provide for correct operation to properly monitor the current for use with LED signal heads.

13. Type 218 ITS Serial Interface Unit

a. Introduction

Supply each input and output assembly with a Type 218 ITS Serial Interface Unit (SIU). Ensure the Type 218 ITS SIU supplied meets the CALTRANS TEES Specifications. Ensure the Unit supplied is listed on the most recent California Department of Transportation Qualified Products List (QPL). The Type 218 ITS SIU shall provide the interface between the 2070 controller and the input and output files.

b. Configuration

Supply Type 218 SIU capable of operating in all input and output modes. Provide a Model 218 SIU that is configured correctly for the input or output file for which it is supplied.

c. Programming

Ensure programming of the Type 218 SIU is programmed by assembly mounted address jumpers and that no other setup is required.

d. Diagnostics

Ensure the Type 218 SIU supplied has a complete set of internal diagnostics self-tests run continuously to monitor critical components of the unit. Provide unit with a front panel LED indicator that can be used to report the current Input/Output assembly address assignment of the unit for cabinet configuration verification. Ensure unite has a diagnostic EIA-232 port on the front panel to interface with the SIU 218 functions.

14. Model 242 DC Isolator

Provide Model 242 DC Isolators that are in accordance with the latest version of CALTRANS Specifications as referenced earlier in this section. Provide isolators that:

- Allow 242 isolator input signal polarity to easily be inverted without the use of tools. Acceptable methods are removable jumpers or dip switches. Unacceptable methods are soldering or desoldering a diode or resistor.
- Output is OFF for input voltages greater than 12 volts;
- Output is ON for voltages of less than 8 volts that have a duration of at least 5 to 25 ms (optional 2-7 ms);
- Minimum output pulse width is 100 ms with a valid input (can be disabled);
- Output is optically isolated open collector NPN transistor;
- Capable of sinking 50 ma when on;
- Can register a new input within 25 ms of the old signal going away; and
- Output clamped on power up and down

15. Model 200 Switchpack

Provide Model 200 Switchpacks that are in accordance with the latest version of CALTRANS Specifications as referenced earlier in this section.

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16. Model 204 Flasher Unit

Provide Model 204 Flasher Units that are in accordance with the latest version of CALTRANS Specifications as referenced earlier in this section.

17. Flash Transfer Relay

Provide Flash Transfer Relays that are in accordance with the latest version of CALTRANS Specifications as referenced earlier in this section.

18. Cabinet Model 342

Provide Cabinet Model 342 that meets the CALTRANS Specification with the addition of surge protection as detailed in [Table 925-13 Model 342 ITS Cabinet Default Input Files Assignment Detail](#), Table 925-14 Required Surge Arrestors for Model 342 ITS Cabinet, and Table 925-15 Model 342 & 346 ITS Cabinet Default Output File Assignment Detail.

Supply Model 342 with lower input panel cabinets, with housing Type 1, and all components as described in these Specifications.

Supply cabinets having two input files which conform to the CALTRANS Specifications and configured to accept two 2070 controllers in the top portion of the cabinet.

Configure the cabinet for dial up communications. Mount a two (2) circuit Buchanan connector on the right side panel (from rear door).

Mount a phone jack with a RJ11 connector above or to the right of the Buchanan terminal block.

Wire the phone jack to the Buchanan and to the Terminal Block (TB0) in accordance with [Figure 925-3](#).

19. Cabinet Model 346 (Base Mount)

This unit meets the CALTRANS Specification with the addition of approximately 6 additional inches (150 mm) of cabinet height exclusive of the "M" base adapter. Configure the internal component layout so that the additional space is available in the bottom area of the cabinet cage. Ensure that the field wiring input panels and surge protection conform to [Table 925-16 Model 346 ITS Cabinet Default Input File Assignment Detail](#), [Table 925-17 Required Surge Arrestors for Model 346 Cabinet](#), and [Table 925-15 Model 342 & 346 Default ITS Cabinet Default Output File Assignment](#).

20. Cabinet Model 346 (Pole Mount)

Ensure that this unit meets the requirements of [Subsection 925.2.04.A.19](#) above, except that the cabinet is configured for pole mounting as specified in the General Requirements for Type ITS Cabinet Assemblies.

21. Cabinet Model 340

The Model 340 cabinet configuration will be determined by the special provisions of the project.

Ensure that the input and output port assignments are compatible with the 2070 controller as applicable according to the required number of input/outputs. Ensure that the 340 cabinet uses standard ITS cabinet input and output file units.

Equip the cabinet with a C2 connector harness with field terminals protected with surge protectors for communication inputs as specified under communications inputs.

Ensure that the cabinet has four full-size doors to allow complete access from the front or back of the cabinet. Design the rack assembly to mount in CALTRANS standard rails to allow for a Model 204 flasher.

Provide a receptacle to accept the plug in power distribution assembly card guides and edge connectors for the input file card guides to support the conflict monitor, and load switches and flash transfer relays.

B. Fabrication

Refer to [Subsection 925.2.07.A.1](#) for controller cabinet minimum fabrication Specifications.

C. Acceptance

Refer to [Subsection 925.2.02.A](#) for compliance with CALTRANS QPL.

D. Materials Warranty

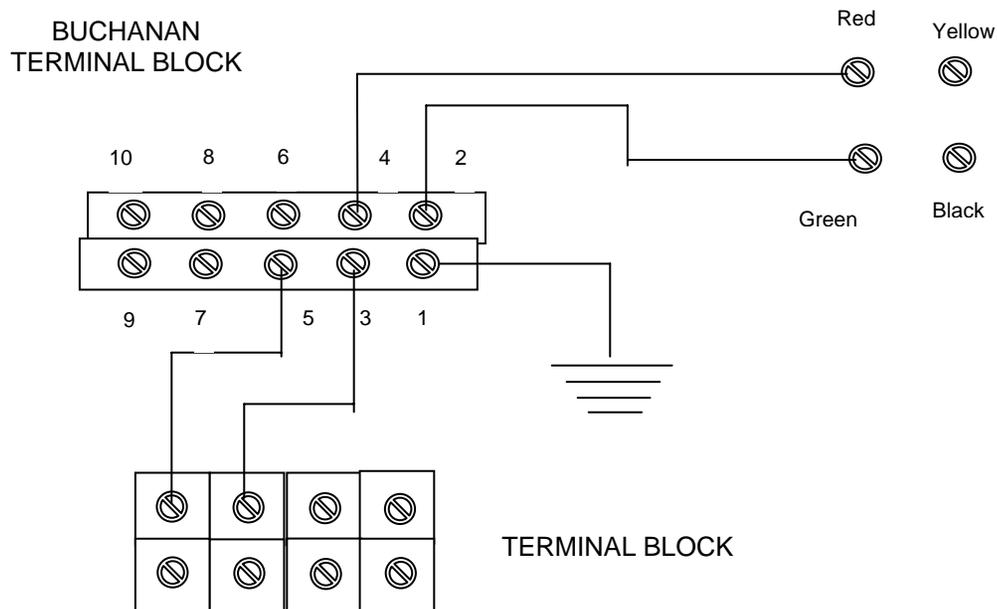
Refer [Subsection 925.2.01.D](#) for Materials Warranties.

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Table 925 – 13 Model 342 ITS Cabinet Default Input Files Assignment Detail														
Input File	Chan	Item	File Slot											
			1	2	3	4	5	6	7	8	9	10	11	12
1	Upper	SIU Pin	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16
		SIU Byte,Bit	2,6	3,0	3,2	3,4	3,6	4,0	4,2	4,4	4,6	5,0	5,2	5,4
		SIU Input #	7	9	11	13	15	17	19	21	23	25	27	29
		2070 Input #	17	0	28	8	22	6	43	25	51	32	12	38
		2070 Port	3,2	1,1	4,5	2,1	3,7	1,7	6,4	4,2	7,4	5,1	2,5	5,7
		Function	Ph 1 Det	Ph 2 Det	Ph 2 Det	Ph 2 Det	Ph 3 Det	Ph 4 Det	Ph 4 Det	Sp Det 1	Sp Det 5	Pd 2 Det	Pre 1	Pre 5
	Field Term	TB-2 1,2	TB-2 5,6	TB-2 9,10	TB-4 1,2	TB-4 5,6	TB-4 9,10	TB-6 1,2	TB-6 5,6	TB-6 9,10	TB-8 4,6	TB-9 10,12	TB-9 5,6	
	Lower	SIU Pin	B5	B6	B7	B8	B9	B10	B11	B12	B13	B14	B15	B16
		SIU Byte,Bit	2,7	3,1	3,3	3,5	3,7	4,1	4,3	4,5	4,7	5,1	5,3	5,5
		SIU Input #	8	10	12	14	16	18	20	22	24	26	28	30
		2070 Input #	21	4	41	19	2	30	10	53	52	34	13	39
		2070 Port	3,6	1,5	6,2	3,4	1,3	4,7	2,3	7,6	7,5	5,3	2,6	5,8
		Function	Ph 1 Det	Ph 2 Det	Ph 2 Det	Ph 3 Det	Ph 4 Det	Ph 4 Det	Ph 4 Det	Sp Det 2	Sp Det 6	Pd 4 Det	Pre 2	Pre 6
	Field Term	TB-2 3,4	TB-2 7,8	TB-2 11,12	TB-4 3,4	TB-4 7,8	TB-4 11,12	TB-6 3,4	TB-6 3,4	TB-6 11,12	TB-8 5,6	TB-9 11,12	TB-9 8,9	
	Opto Inputs	SIU Pin	B25	A26	B26	A27								
		SIU Byte,Bit	8,7	9,0	9,1	9,2								
		SIU Input #	Opto In 1	Opto In 2	Opto In 3	Opto In 4								
		2070 Input #	46	14	47	45								
2070 Port		6,7	2,7	6,6	6,8									
Function		Flsh Sen	MCE	Int Adv	S T									
2	Upper	SIU Pin	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16
		SIU Byte,Bit	2,6	3,0	3,2	3,4	3,6	4,0	4,2	4,4	4,6	5,0	5,2	5,4
		SIU Input #	7	9	11	13	15	17	19	21	23	25	27	29
		2070 Input #	16	1	29	9	18	7	44	54	49	33	36	15
		2070 Port	3,1	1,2	4,6	2,2	3,3	1,8	6,5	7,7	7,2	5,2	5,5	2,8
		Function	Ph 5 Det	Ph 6 Det	Ph 6 Det	Ph 6 Det	Ph 7 Det	Ph 8 Det	Ph 8 Det	Sp Det 3	Sp Det 7	Pd 6 Det	Pre 3	Spare 1
	Field Term	TB-3 1,2	TB-3 5,6	TB-3 9,10	TB-5 1,2	TB-5 5,6	TB-5 9,10	TB-7 1,2	TB-7 5,6	TB-7 9,10	TB-8 7,9	TB-9 4,6	TB-8 1,3	
	Lower	SIU Pin	B5	B6	B7	B8	B9	B10	B11	B12	B13	B14	B15	B16
		SIU Byte,Bit	2,7	3,1	3,3	3,5	3,7	4,1	4,3	4,5	4,7	5,1	5,3	5,5
		SIU Input #	8	10	12	14	16	18	20	22	24	26	28	30
		2070 Input #	20	5	42	18	3	31	11	55	50	35	37	40
		2070 Port	3,5	1,6	6,3	3,3	1,4	4,8	2,4	7,8	7,3	5,4	5,6	6,1
		Function	Ph 5 Det	Ph 6 Det	Ph 6 Det	Ph 7 Det	Ph 8 Det	Ph 8 Det	Ph 8 Det	Sp Det 4	Sp Det 8	Pd 8 Det	Pre 4	Spare 2
	Field Term	TB-3 3,4	TB-3 7,8	TB-3 11,12	TB-5 3,4	TB-5 7,8	TB-5 11,12	TB-7 3,4	TB-7 7,8	TB-7 11,12	TB-8 8,9	TB-9 7,9	TB-8 2,3	
	Opto Inputs	SIU Pin	B25	A26	B26	A27								
		SIU Byte,Bit	8,7	9,0	9,1	9,2								
		SIU Input #	Opto In 1	Opto In 2	Opto In 3	Opto In 4								
		2070 Input #	NA	NA	NA	NA								
2070 Port														
Function														

Field Terminal Block	Terminals	Required Arrestors for Model 342 Cabinet
TB - 8	1-12	Section 925.2.05.A.10.f
TB - 9	10-12	Section 925.2.05.A.10.f
TB - 9	4-9	Section 925.2.05.A.10.f
TB - 2, TB - 3, TB - 4, TB - 5, TB - 6, TB - 7	1-12	Section 925.2.05.A.10.c

Item	Switch Pack													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
SIU Pin	A2	B3	A5	B6	A8	B9	A11	B12	A14	B15	A17	B18	A20	B21
SIU Byte, Bit	2,0	2,3	2,6	3,1	3,4	3,7	4,2	4,5	5,0	5,3	5,6	6,1	6,4	6,7
SIU Output #	1	4	7	10	13	16	19	22	25	28	31	34	37	40
2070 Output #	13	10	8	5	2	0	29	26	24	21	18	16	53	50
2070 Output Port	2.6	2.3	2.1	1.6	1.3	1.1	4.6	4.3	4.1	3.6	3.3	3.1	7.6	7.3
AMU Pin	C16	C17	C18	C19	C20	C21	C22	C23	C24	C25	C26	C27	C28	C29
AMU Channel	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Field Term	TR-1 1,2	TR-2 1,2	TR-3 1,2	TR-4 1,2	TR-5 1,2	TR-6 1,2	TR-7 1,2	TR-8 1,2	TR-9 1,2	TR-10 1,2	TR-11 1,2	TR-12 1,2	TR-13 1,2	TR-14 1,2
Function	Ph 1 Rd	Ph 2 Rd	Pd 2 DW	Ph 3 Rd	Ph 4 Rd	Pd 4 DW	Ph 5 Rd	Ph 6 Rd	Pd 6 DW	Ph 7 Rd	Ph 8 Rd	Pd 8 DW	Ov A Rd	Ov B Rd
SIU Pin	B2	A4	B5	A7	B8	A10	B11	A13	B14	A16	B17	A19	B20	A22
SIU Byte, Bit	2,1	2,4	2,7	3,2	3,5	4,0	4,3	4,6	5,1	5,4	5,7	6,2	6,5	7,0
SIU Output #	2	5	8	11	14	17	20	23	26	29	32	35	38	41
2070 Output #	14	11	32	6	3	34	30	27	33	22	19	35	54	51
2070 Output Port	2.7	2.4	5.1	1.7	1.4	5.3	4.7	4.4	5.2	3.7	3.4	5.4	7.7	7.4
AMU Pin	B16	B17	B18	B19	B20	B21	B22	B23	B24	B25	B26	B27	B28	B29
AMU Channel	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Field Term	TR-1 3,4	TR-2 3,4	TR-3 3,4	TR-4 3,4	TR-5 3,4	TR-6 3,4	TR-7 3,4	TR-8 3,4	TR-9 3,4	TR-10 3,4	TR-11 3,4	TR-12 3,4	TR-13 3,4	TR-14 3,4
Function	Ph 1 Yel	Ph 2 Yel	Pd 2 PC	Ph 3 Yel	Ph 4 Yel	Pd 4 PC	Ph 5 Yel	Ph 6 Yel	Pd 6 PC	Ph 7 Yel	Ph 8 Yel	Pd 8 PC	Ov A Yel	Ov B Yel
SIU Pin	A3	B4	A6	B7	A9	B10	A12	B13	A15	B16	A18	B19	A21	B22
SIU Byte, Bit	2,2	2,5	3,0	3,3	3,6	4,1	4,4	4,7	5,2	5,5	6,0	6,3	6,6	7,1
SIU Output #	3	6	9	12	15	18	21	24	27	30	33	36	39	42
2070 Output #	15	12	9	7	4	1	31	28	25	23	20	17	55	52
2070 Output Port	2.8	2.5	2.2	1.8	1.5	1.2	4.8	4.5	4.2	3.8	3.5	3.2	7.8	7.5
AMU Pin	A16	A17	A18	A19	A20	C21	C22	C23	A24	A25	A26	A27	A28	A29
AMU Channel	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Field Term	TR-1 5,6	TR-2 5,6	TR-3 5,6	TR-4 5,6	TR-5 5,6	TR-6 5,6	TR-7 5,6	TR-8 5,6	TR-9 5,6	TR-10 5,6	TR-11 5,6	TR-12 5,6	TR-13 5,6	TR-14 5,6
Function	Ph 1 Grn	Ph 2 Grn	Pd 2 W	Ph 3 Grn	Ph 4 Grn	Pd 4 W	Ph 5 Grn	Ph 6 Grn	Pd 6 W	Ph 7 Grn	Ph 8 Grn	Pd 8 W	O A Grn	O B Grn



Note: For a typical signal installation, the Model 342 cabinet is the design standard.

Figure 925-3—Wiring Diagram for Dial-up Communications

Table 925 - 16 Model 346 ITS Cabinet Default Input Files Assignment Detail

Input File	Channel	Item	File Slot											
			1	2	3	4	5	6	7	8	9	10	11	12
1	Upper	SIU Pin	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16
		SIU Port	2,6	3,0	3,2	3,4	3,6	4,0	4,2	4,4	4,6	5,0	5,2	5,4
		SIU In #	7	9	11	13	15	17	19	21	23	25	27	29
		2070 In #	17	0	19	2	16	1	18	3	12	36	32	33
		2070 Port	3.2	1.1	3.4	1.3	3.1	1.2	3.3	1.4	2.5	5.5	5.1	5.2
		Function	Ph 1 Det	Ph 2 Det	Ph 3 Det	Ph 4 Det	Ph 5 Det	Ph 6 Det	Ph 7 Det	Ph 8 Det	Pre 1	Pre 3	Pd 2 Det	Pd 6 Det
		Fld Term	T-7 1,2	T-7 5,6	T-7 9,10	T-8 1,2	T-8 5,6	T-8 9,10	T-9 1,2	T-9 5,6	T-5 1,2	T-5 5,6	T-4 1,2	T-4 5,6
	Lower	SIU Pin	B8	B9	B10	B11	B12	B13	B14	B15	B16	B17	B18	B19
		SIU Port	2,7	3,1	3,3	3,5	3,7	4,1	4,3	4,5	4,7	5,1	5,3	5,5
		SIU In #	8	10	12	14	16	18	20	22	24	26	28	30
		2070 In #	8	4	10	6	9	5	11	7	13	37	34	35
		2070 Port	2.1	1.5	2.3	1.7	2.2	1.6	2.4	1.8	2.6	5.6	5.3	5.4
		Function	Ph 2 Det	Ph 2 Det	Ph 4 Det	Ph 4 Det	Ph 5 Det	Ph 6 Det	Ph 7 Det	Ph 8 Det	Pre 2	Pre 4	Pd 4 Det	Pd 8 Det
		Fld Term	T-7 3,4	T-7 7,8	T-7 11,12	T-8 3,4	T-8 7,8	T-8 11,12	T-9 3,4	T-9 7,8	T-5 3,4	T-5 7,8	T-4 3,4	T-4 7,8
	Opto	SIU Pin	B25	A26	B26	A27								
		SIU Port	8,7	9,0	9,1	9,2								
		SIU In #	Opto In 1	Opto In 2	Opto In 3	Opto In 4								
		2070 In #	46	14	47	45								
		2070 Port	6.7	2.7	6.6	6.8								
		Function	Fish Sen	MCE	Int Adv	S T								

Table 925 – 17 Required Surge Arrestors for Model 346 ITS Cabinet

Field Terminal Block	Terminals	Required Arrestors for Model 346 Cabinet
TB – 4	1-12	Section 925.2.05.A.10.f
TB - 5	1-4	Section 925.2.05.A.10.f
TB - 5	5-12	TERMINAL BLOCK Only Section 925.2.05.A.10.f
TB - 7, TB - 8, TB – 9	1-12	Section 925.2.05.A.10.c

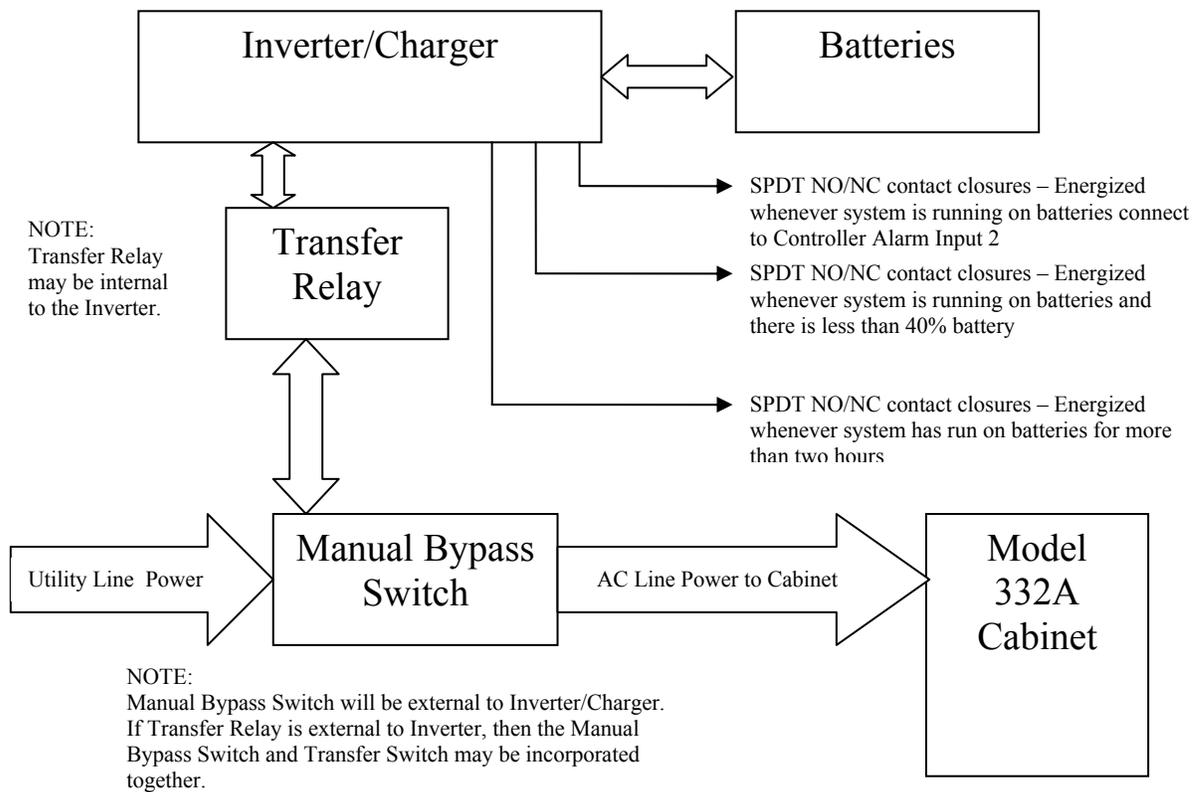
925.2.06 Battery Backup System

A. Requirements

This specification is for establishing the minimum requirements for a complete emergency battery backup system for use with Light Emitting Diode Traffic Signal Modules at intersections with 332 cabinets. The Battery Backup System (BBS) shall include, but not be limited to the following: Inverter/Charger, Power Transfer Relay, Batteries, a separate manually operated non-electric Bypass Switch and all necessary hardware and interconnect wiring. The BBS shall be capable of providing power for full run-time operation for an “LED-only” intersection (all colors: red, yellow, green and pedestrian heads) or flashing mode operation and intersection Red LED’s. The BBS shall be designed for outdoor applications, in accordance with the CALTRANS TEES.

Figure 925-4 Battery Backup Block Diagram

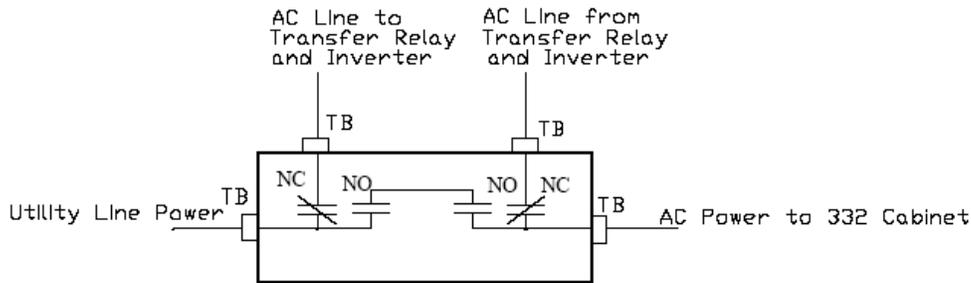
Battery Back Up System (BBS) Block Diagram



1. Operation:

- a. The BBS shall provide a minimum two (2) hours of full run-time operation for an “LED-only” intersection (minimum 700W/1000VA active output capacity, with 80% minimum inverter efficiency).
- b. The maximum transfer time allowed, from disruption of normal utility line voltage to stabilized inverter line voltage from batteries, shall be 65 milliseconds. The same maximum allowable transfer time shall also apply when switching from inverter line voltage to utility line voltage.
- c. The BBS shall include a Manual Bypass Switch which provides capability to transfer the power service to disable the BBS and operate only from the power service provided. The Manual Bypass Switch shall be as shown in Figure 925-5.

Figure 925 – 5 Manual Bypass Switch (Shown in normal BBS Mode)

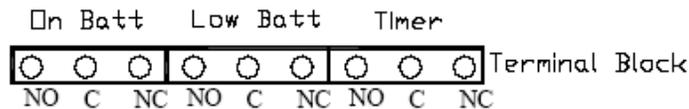


Notes:

1. TB - #8 Terminal Blocks
2. NO - Normally Open
3. NC - Normally Closed
4. NO/NC contacts shall all toggle simultaneously with one single manually operated switch.
5. Manual Bypass Switch shall only switch line. Neutral and Equipment Ground are not switched and shall be connected to 332 Cabinet buses.

- d. The BBS shall provide the user with 3-sets of normally open (NO) and normally closed (NC) single-pole double-throw (SPDT) dry relay contact closures, available on a panel-mounted terminal block, rated at a minimum 120V/1A, and labeled so as to identify each contact. For typical configuration, see Figure 925-6.
- 1) The first set of NO and NC contact closures shall be energized whenever the unit switches to battery power. Contact shall be labeled or marked "On Batt."
 - 2) The second set of NO and NC contact closures shall be energized whenever the battery approaches approximately 40% of remaining useful capacity. Contact shall be labeled or marked "Low Batt."
 - 3) The third set of NO and NC contact closures shall be energized two hours after the unit switches to battery power. Contact shall be labeled or marked "Timer."
 - 4) Relay contact activation shall be annunciated on the front panel via a visual indication. This can be either discreet LED, or part of LCD screen, etc.

Figure 925 – 6 Relay Contacts (NO/NC) available on panel-mounted terminal block (typ)



Notes:

1. NO/NC contacts may either share or use separate commons.

- e. Operating temperature for both the inverter/charger, power transfer relay and manual bypass switch shall be -37°C (-35F) to $+74^{\circ}\text{C}$ ($+165\text{F}$).
- f. Both the Power Transfer Relay and Manual Bypass Switch shall be rated at 240VAC/30 amps, minimum
- g. The BBS shall use a temperature-compensated battery charging system. The charging system shall compensate over a range of 2.5 – 4.0 mV/ $^{\circ}\text{C}$ (5-8 F) per cell. The temperature sensor shall be external to the inverter/charger unit. The temperature sensor shall come with 3 meters (10 feet) of wire. Ensure temperature sensor can be mounted to battery with ring terminal to prevent losing connectivity.
- h. Batteries shall not be recharged when battery temperature exceeds 50°C (122F) $\pm 3^{\circ}\text{C}$ (6 F).

Section 925—Traffic Signal Equipment

- i. BBS shall bypass the utility line power whenever the utility line voltage is outside of the following voltage range: 100VAC to 130VAC (± 2 VAC).
- j. When utilizing battery power, the BBS output voltage shall be between 110 VAC and 125 VAC, pure sine wave output, $\leq 3\%$ THD, $60\text{Hz} \pm 3\text{Hz}$.
- k. BBS shall be compatible with CALTRANS Model 332A Cabinets, Model 170E Controllers, Model 2070 Controllers and cabinet components for full time operation.
- l. In cases of low (below 98VAC) or absent utility line power, when the utility line power has been restored at above $105\text{VAC} \pm 2\text{VAC}$ for more than 30 seconds, the BBS shall transfer from battery backed inverter mode back to utility line mode.
- m. In cases of high utility line power (above 132VAC), when the utility line power has been restored at below $125\text{VAC} \pm 2\text{VAC}$ for more than 30 seconds, the BBS shall transfer from battery backed inverter mode back to utility line mode
- n. BBS shall be equipped to prevent a malfunction feedback to the cabinet or from feeding back to the utility service.
- o. In the event of inverter/charger failure, battery failure or complete battery discharge, the power transfer relay shall revert to the NC (and de-energized) state, where utility line power is connected to the cabinet.
- p. Recharge time for the battery, from “protective low-cutoff” to 80% or more of full battery charge capacity, shall not exceed twenty (20) hours.

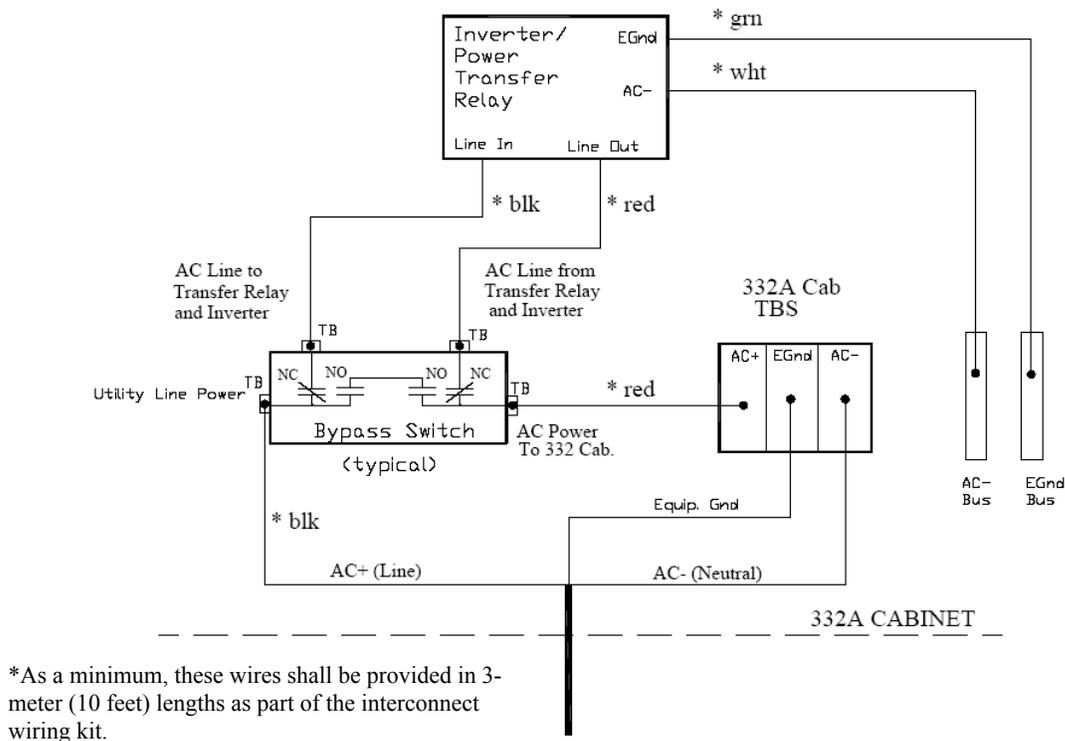
2. Mounting/Configuration

NOTE: All references made to EIA rail or EIA 19” (482.6mm) rack shall conform to Electronic Industries Standards EIA-310-B, Racks, Panels, and Associated Equipment, with 10-32 “Universal Spacing” threaded holes.

a. General

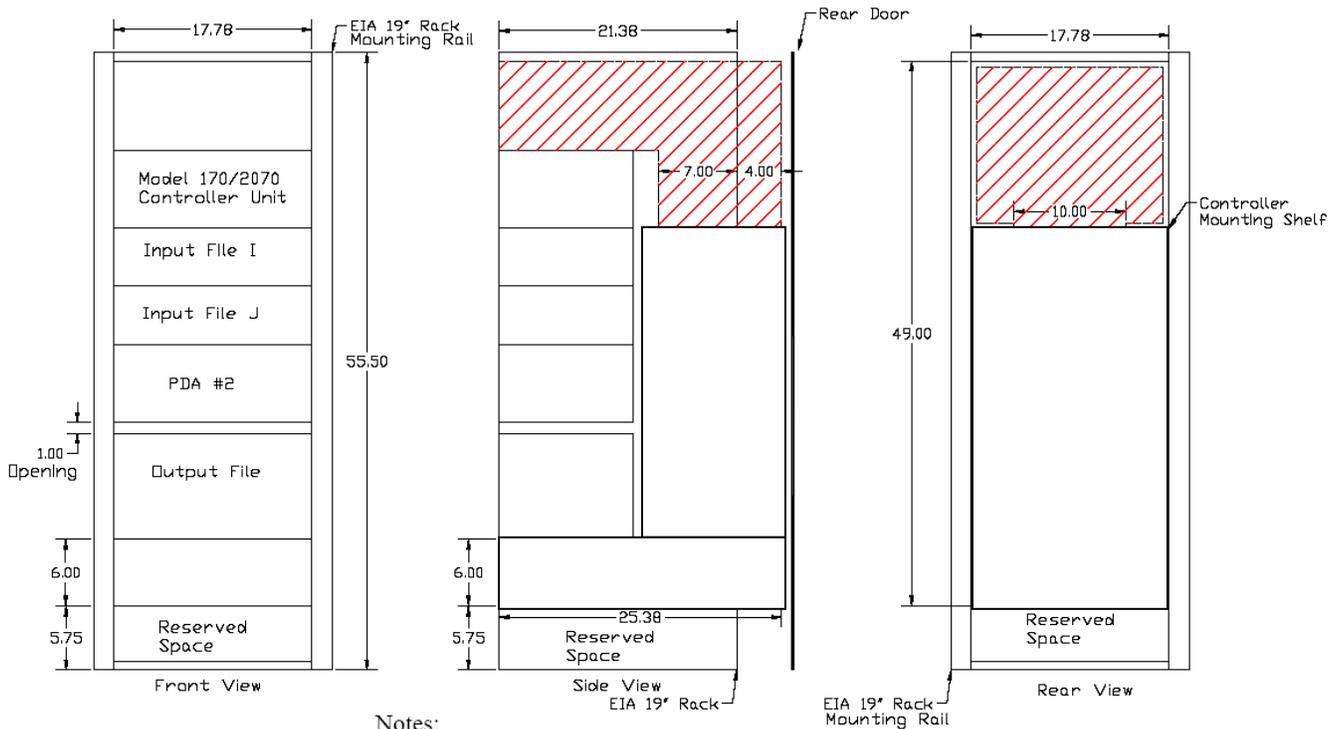
- 1) Inverter/Charger Unit shall be shelf-mounted or rack-mounted on a standard EIA 19” rack. If the inverter/charger is mounted inside the 332A Cabinet (Configuration 1), a shelf shall be provided that supports the weight of the unit.
- 2) Power Transfer Relay and Manual Bypass Switch shall be mounted on EIA rail.
- 3) All interconnect wiring shall be provided between Power Transfer Relay, Bypass Switch and Cabinet Terminal Service Block and shall be no less than 3 meters (9’10”) of UL Style 1015 CSA TEW with the following characteristics:
 - AWG Rating: 6 AWG
 - Stranding: 133 strands of 30 AWG tinned copper
 - Rating: 600 V, 105 °C, PVC Insulation
- 4) Relay contact wiring provided for each set of NO/NC relay contact closure terminals shall be a minimum of 3 meters (10 feet) of UL Style 1015 CSA TEW 18 AWG wire, same ratings as above, except 16 strands of 30 AWG tinned copper. Wiring shall be of adequate length for particular installation.
- 5) Figure 925-7 provides clarification as to how BBS Power Transfer Relay and Manual Bypass Switch are interconnected with Model 332A Cabinets in order to ensure interchangeability between all BBS manufacturers.

Figure 925- 7 BBS Utility Power Connection Diagram



- 6) All necessary hardware for mounting (shelf angles, rack, etc) shall be included in the bid price of the BBS. All bolts/fasteners and washers shall meet the following requirements:
 - Screw type: Pan Head Phillips machine screw
 - Size and Thread pitch: 10-32
 - Material: 18-8 stainless steel (Type 316 stainless steel is acceptable as an alternate)
 - Washer: Use one flat washer (18-8 stainless steel) under the head of each 10-32 screw (provided that the screws are properly tightened, lock washers are unnecessary.)
 - Number of screws per hinge bracket: Minimum of six (6) screws per hinge bracket spaced evenly along bracket, with one screw near each end.
- 7) There shall be two (2) basic BBS mounting options:
 - a) Configuration 1 – The BBS (Inverter/Charger, Bypass Switch and Transfer Relay only) installed inside the 332A Cabinet, with the batteries installed in the externally mounted cabinet. See Figure 925-8 for location of inverter in 332A cabinet.
 - b) Configuration 2 – The entire BBS, including batteries, installed inside the externally mounted cabinet.

Figure 925-8 BBS Mounting Diagram
For a typical Model 332A Cabinet



Notes:
Area inside of dashed lines represents available mounting locations for BBS.
Prescribed available mounting areas are approximate.
All dimensions shown are in inches.

8) External Cabinet

- a) The External Cabinet shall be used for housing batteries and/or BBS, which includes inverter/charger unit, power transfer relay, manually operated bypass switch, any other control panels, and all wiring and harnesses.
- b) The same Inverter/Charger, Power Transfer Relay and manually operated Bypass Switch that fits inside a typical fully equipped CALTRANS Model 332A Cabinet shall also be able to fit inside the externally mounted cabinet.
- c) The External Cabinet shall be a NEMA 3R rated cabinet conforming to TEES, August 16, 2002 Chapter 7, Section 2-Housings for the construction and finish of the cabinet. The specific finish of the external cabinet shall match the finish of the 332A cabinet. Anti-Graffiti paint shall not be used. Two separate mounting installations shall be used. Refer to the project plans for the appropriate mounting installation.
 - i. *Mounting Installation Type A shall be typically used for installing at locations with existing 332 cabinet. This cabinet mounting installation shall attach the external cabinet to the side of the 332 cabinet in the relationship as shown in figure 925-9. Type A mounting installation shall use fasteners that meet the following requirements:*
 - (Total of 8 bolts per cabinet with 2 flat washers per bolt and 1 K-lock nut per bolt)
 - Cabinet mounting bolts shall be:
 - 18-8 Stainless Steel Hex Head (Fully Threaded)
 - 3/8" – 16 X 1"
 - Washers shall be:
 - Designed for 3/8" bolt
 - 18-8 Stainless Steel 1" OD round flat type
 - K-lock washer shall be:
 - 18-8 Stainless Steel, Hex Nut Assembled with Free-Spinning Tooth Washer
 - 3/8" – 16 Screw size

External Cabinet to 332A Cabinet couplings shall provide a conduit for power connections between the 332A Cabinet and External Cabinet. The couplings shall consist of three parts and meet the following requirements:

- 2" Nylon Insulated, Steel Chase Nipple
- 2" Sealing, Steel Locknut
- 2" Nylon Insulated, Steel Bushing

The external cabinet shall come provided with all bolts, washers, nuts and cabinet-cabinet coupler fittings provided, necessary for mounting the external cabinet to the 332A Cabinet.

ii. Mounting Installation Type B shall be typically used for locations where a new traffic controller cabinet and foundation are being installed. This cabinet installation shall provide the external battery cabinet as a base mount cabinet on the same foundation as the 332 cabinet.

Connections between the cabinets shall be through conduit in the cabinet base. The external cabinet shall be installed in the same relationship as shown in figure 925-9 to the 332 cabinet. The external cabinet shall be installed so that it is centered on the 30 inch left side of the 332 cabinet. Bolt BBS cabinet to pre-fab base. BBS cabinet opening shall be larger than the pre-fab base opening.

d) The specific dimensions and details of the external battery cabinet shall be as shown in Figures 925 – 10 through 925 – 12.

Figure 925-9 External BBS Cabinet Details

External Battery Cabinet

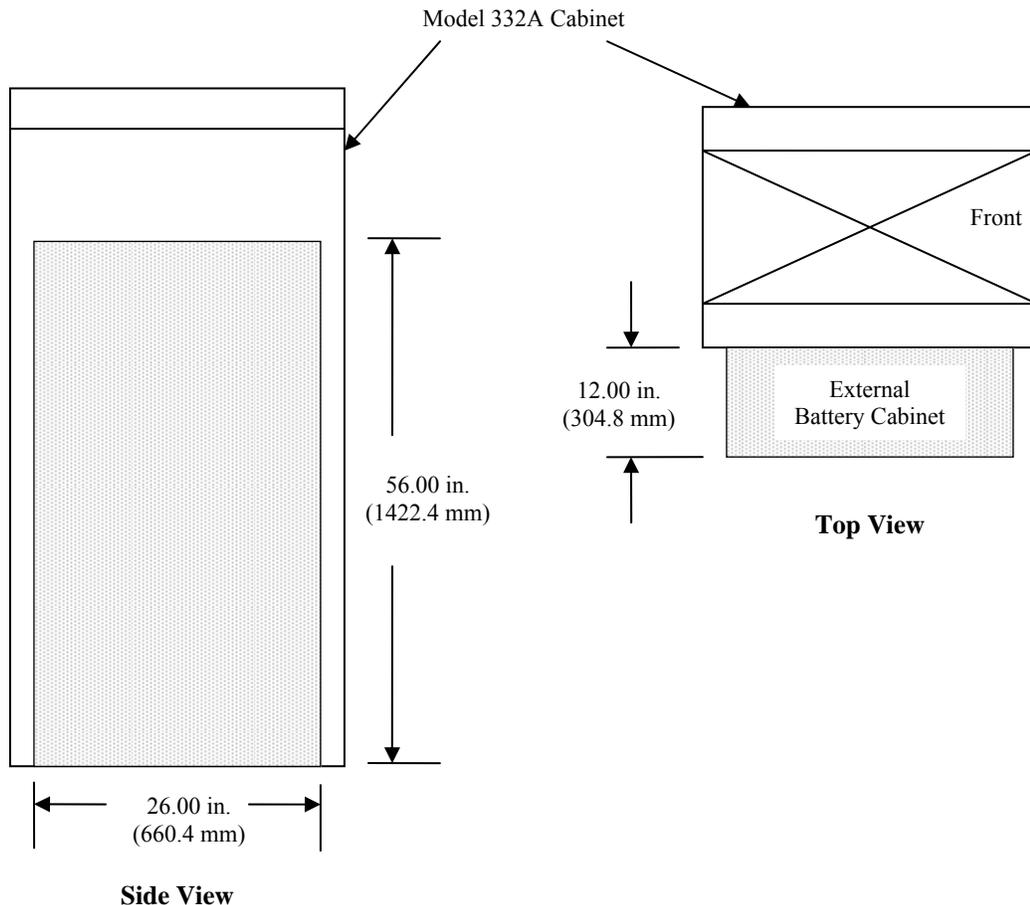
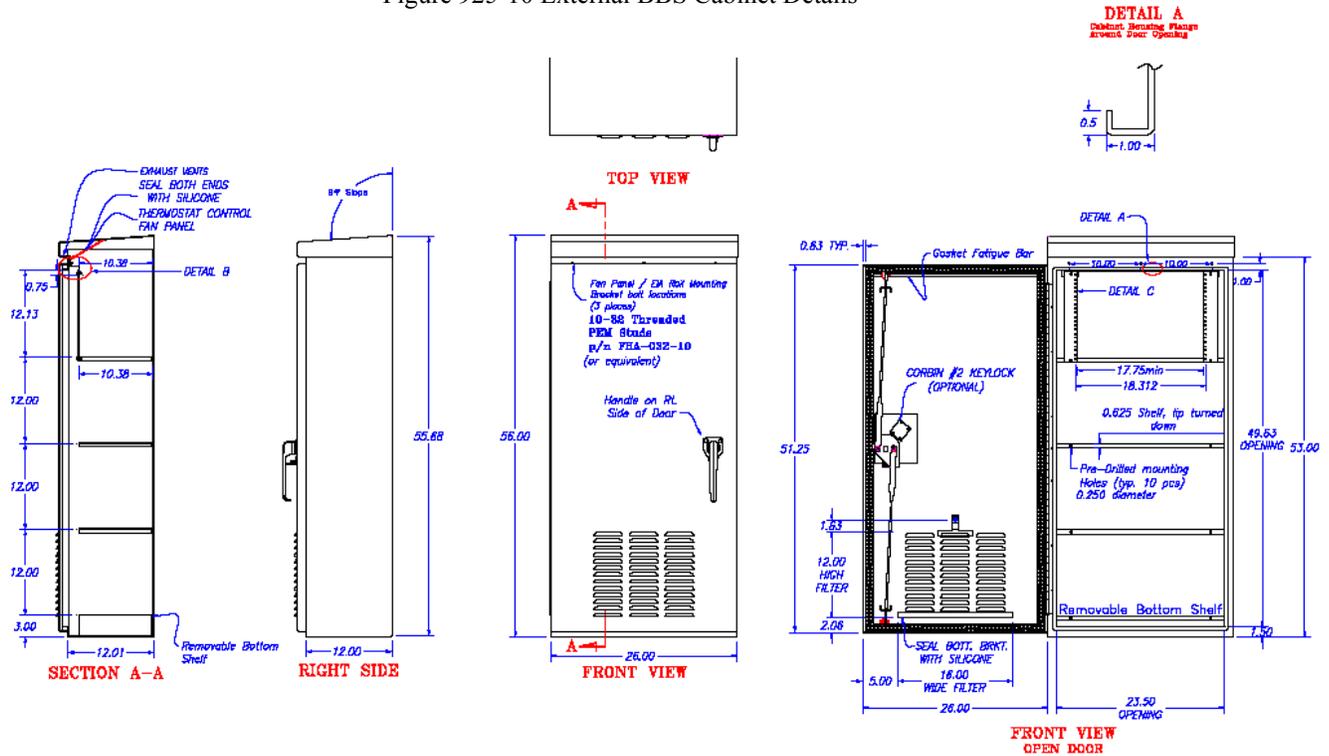
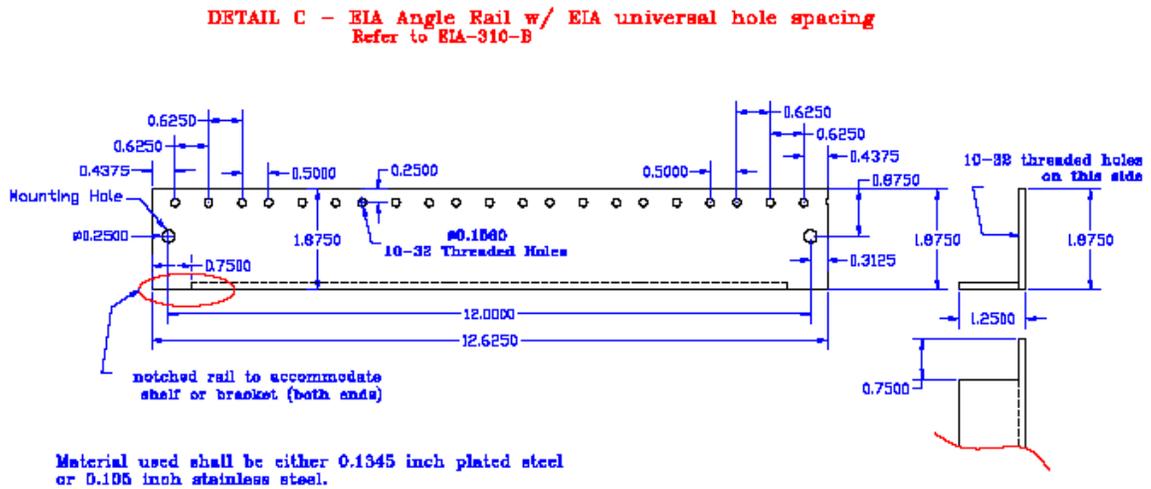


Figure 925-10 External BBS Cabinet Details



- e) Four shelves shall be provided. There shall be a minimum of 304.8mm (12”) clearance between shelves. Each shelf shall be a minimum of 263.65mm (10.38”) X 635.0mm (25”), and capable of supporting a minimum of 57kg (125 lbs.). Shelf edges shall be turned down on all four sides for support and to provide a flat top surface. Shelves shall be predrilled with EIA rail mounting holes. Shelves shall provide a vertical “passageway” for wiring in the rear of the cabinet on both the left and right.
- f) The bottom shelf shall be capable of being removed.

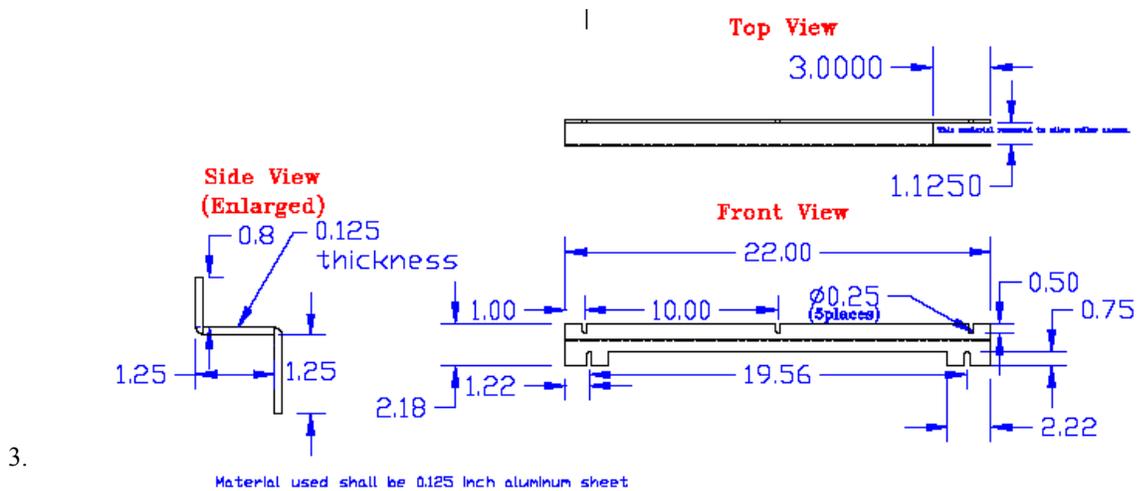
Figure 925-11 EIA Rail for Mounting Inverter or PTR inside External BBS Cabinet



- g) The External cabinet shall be ventilated through the use of louvered vents, filter, and one thermostatically controlled fan as per TEES Chapter 7 Section 2-Housings. The thermostat shall be accessible without removing the BBS controller.

- h) External cabinet fan shall be AC operated from the same line output of the Manual Bypass Switch that supplies power to the 332 Cabinet. A 2-position terminal block shall be provided on the fan panel, along with 3 meters (10 feet) of connected hookup wire.
- i) The door shall be attached to the cabinet through the use of either a continuous stainless steel piano hinge or four, two-bolts per leaf, hinges as per TEES Chapter 7 Section 2. The door shall use a padlock clasp or latch and lock mechanisms as described in the TEES, in order to lock the door.
- j) Two EIA angle rails, per Detail C, Figure 925 – 11, along with all necessary mounting hardware (4 sets of 10-32 bolts and nuts with captive washers) shall be provided with the external cabinet (not installed). Rails shall be symmetric to allow for installation on either right or left sides of the cabinet. Mounting holes and bracket shall allow for EIA rail installation at any location in the external cabinet. The EIA mounting angle nominal thickness shall be either 0.1345 inch (3.4163mm) plated steel or 0.105 inch (2.667mm) stainless steel.
- k) EIA rail mounting bracket shall be of continuous, one-piece design bolted into the cabinet to provide adequate support for rail-mounted equipment. See Figure 925 – 12.
- l) Pressed in, flush-head threaded screw posts shall be inserted into the front face of the cabinet enclosure top sill. These threaded posts shall be used to mount both the fan panel and the EIA rail-mounting bracket. The screw posts shall be #10-32 thread size stud 0.625 inches in length. Refer to Figure 925 – 10, front views for mounting detail.

Figure 925 – 12 EIA Rail Mounting Bracket for Mounting EIA Rails inside External BBS Cabinet



Maintenance, Displays, Controls and Diagnostics

- a. The BBS shall include a display and /or meter to indicate current battery charge status and conditions.
 - 1) The BBS shall provide voltmeter standard probe input-jacks (+) and (-) to read the exact battery voltage drop at the inverter input.
 - 2) The BBS shall include a 0 to 100% battery capacity LED indicator.
- b. The BBS shall have lightning surge protection compliant with IEEE/ANSI C.62.41.
- c. The BBS shall be equipped with an integral system to prevent battery from destructive discharge and overcharge.
- d. The BBS and batteries shall be easily replaced with all needed hardware and shall not require any special tools for installation.
- e. The BBS shall include a front-panel event counter display to indicate the number of times the BBS was activated and a front-panel hour meter to display the total number of hours the unit has operated on battery power. Both meters shall be resettable.
- f. Manufacturer shall include a set of equipment lists, operation and maintenance manuals, and board-level schematic and wiring diagrams of the BBS, and the battery data sheets. Manual shall conform to TEES August 16, 2002, Chapter 1, Section 1.2.4.2.

4. Battery System

- a. Individual batteries shall be:
 - 1) Voltage rating: 12V type
 - 2) Group size: 24 maximum
 - 3) Batteries shall be easily replaced and commercially available off the shelf.
- b. Batteries used for BBS shall consist of 4 to 8 batteries with a cumulative minimum rated capacity of 240 amp-hours.
- c. Batteries shall be deep cycle, sealed prismatic lead-calcium based AGM/VRLA (Absorbed Glass Mat/ Valve Regulated Lead Acid).
- d. Batteries shall be certified by the manufacturer to operate over a temperature range of -25°C (-13F) to $+74^{\circ}\text{C}$ (+165 F).
- e. The batteries shall be provided with appropriate interconnect wiring and corrosion-resistant mounting trays and/or brackets appropriate for the cabinet into which they will be installed.
- f. Batteries shall indicate maximum recharge data and recharging cycles.
- g. Battery Harness
 - 1) Battery interconnect wiring shall be via two-part modular harness.
 - 2) Part I shall be equipped with red (+) and black (-) 30.48 cm (12 inches) cabling that can be permanently connected to the positive and negative posts of each battery. Each red and black pair shall be terminated into an Anderson Power Pole Connector or AMP Power Series Connector or equivalent style connector.
 - 3) Part II shall be equipped with the mating Power Pole style connector for the batteries and a single, insulated Power Pole style connection to the inverter/charger unit. Harness shall be fully insulated and constructed to allow batteries to be quickly and easily connected in any order to ensure proper polarity and circuit configuration.
 - 4) Power Pole style connectors may be either one-piece or two-piece. If a two-piece connector is used, a locking pin shall be used to prevent the connectors from separating.
 - 5) The length of the battery interconnect harness (Part II) shall be a minimum of 152.4 cm (60 inches) from the Inverter/Charger plug to the first battery in the string. The lateral length of the harness between battery connectors shall be a minimum of 30.48 cm (12 inches).
 - 6) All battery interconnect harness wiring shall be UL Style 1015 CSA TEW or Welding Style Cable or equivalent, all of proper gauge with respect to design current and with sufficient strand count for flexibility and ease of handling.
 - 7) Battery terminals shall be covered and insulated with molded boots so as to prevent accidental shorting.

B. Fabrication

Refer to [Subsection 925.2.07.A.1](#) for controller cabinet minimum fabrication Specifications.

C. Acceptance

General Provisions 101 through 150. Each BBS shall be manufactured in accordance with a manufacturer Quality Assurance (QA) program. The QA program shall include two Quality Assurance procedures: (1) Design QA and (2) Production QA. The Production QA shall include statistically controlled routine tests to ensure minimum performance levels of BBS units built to meet this specification and a documented process of how problems are to be resolved. The manufacturer, or an independent testing lab hired by the manufacturer, shall perform Design Qualification Testing on new BBS system(s) offered, and when any major design change has been implemented on an existing design. A major design change is defined as any modification, material, electrical, physical or theoretical, that changes any performance characteristics of the system, or results in a different circuit configuration. Where a dispute arises in determining if a system is a new design or if the system has had a major design change, the State will make the final determination if Design Qualification Testing is required prior to production consideration.

Production Quality Control tests shall be performed on each new system prior to shipment. Failure to meet this requirements shall be cause for rejection. The manufacturer shall retain test results for seven years. Each BBS shall be given a minimum 100-hour burn-in period to eliminate any premature failures. Each system shall be visually inspected for any exterior physical damage or assembly anomalies. Any defects shall be cause for rejection.

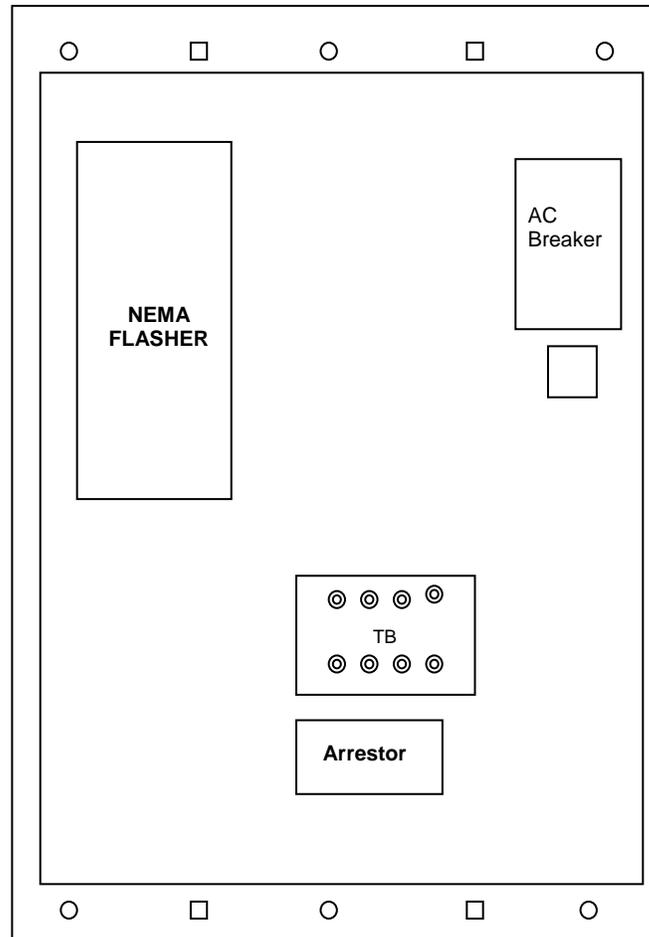
D. Materials Warranty

Refer to [Subsection 925.2.01.D](#) for Materials Warranties. Manufacturers shall provide a two (2) year factory-repair warranty for parts and labor on the BBS from date of acceptance by the Department. Batteries shall be warranted for full replacement for two (2) years from date of purchase. The warranty shall be included in the total bid price of the BBS.

925.2.07 Flashing Beacon Assembly

A. Requirements

This specification is for a flashing signal cabinet, which consists of an aluminum cabinet containing a flasher assembly, Field connection terminal block, surge arrestor and circuit breaker wired in a manner to operate flashing beacons. Refer to [Figure 925-13](#).



Note: Front view of cabinet Door Assembly not shown
No scale

Figure 925-13—Typical Flashing Signal Cabinet Layout

1. Cabinet

Supply a NEMA Type 3R cabinet assembly, manufactured of aluminum with a minimum thickness of 0.125 inches (3 mm).

Ensure that the cabinet exterior has a smooth, uniform “bare” aluminum finish with all joints between adjoining cabinet components (sides and bottom) continuously welded on the outside to prevent the intrusion of moisture and dust.

Ensure that all welds are free of cracks, blow holes and other irregularities.

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Supply a cabinet with the following exterior dimensions:

	<u>Minimum</u>	<u>Maximum</u>
Height	14 inches (350 mm)	18 inches (450 mm)
Width	10 inches (250 mm)	14 inches (350 mm)
Depth	7 inches (175 mm)	10 inches (250 mm)

Use a cabinet door that is double flanged on all four sides to prevent the entry of dirt and liquids when the door is open.

Install a one-piece gasket formed around the door opening to insure a weather tight seal when the door is secured.

Attach the door to the cabinet housing by a continuous tamper proof hinge.

Equip each cabinet with a Corbin #2 lock and one key. Police panel type locks are not acceptable.

Install an aluminum back panel in the cabinet, mounted on standoffs, to facilitate mounting of internal components.

Install exterior aluminum mounting brackets, which extend a minimum of 1.75 inches (44 mm) and a maximum of 2.5 inches (63 mm) from the top and bottom of the cabinet.

Use brackets that extend across the full width of the cabinet back on the top and bottom.

Provide these brackets with holes for mounting to a flat surface with screws and vertical slots for banding to steel, concrete or wooden signal poles.

2. Flasher Unit

Supply a standard plug in two circuits NEMA flasher.

Ensure that the flasher is of all solid state construction, meets the requirements of the NEMA Standards and is rated at a minimum of 10 A per circuit.

Ensure that the flasher utilizes zero voltage turn-on and turn-off current and is capable of dimming outputs.

3. Surge Arrestor

Supply a flasher cabinet that incorporates an AC surge arrestor to protect the internal components from lightning and over voltages on the AC service input.

The requirements for the surge arrestor are:

Two Stage Arrestor	
Peak Surge Current	20000 A
Peak Surge Voltage @ 20KA	280 V
Clamp Voltage	280 V @ 20 kA
Continuous AC Voltage	120 V AC RMS
Response Time	<5 nsec
Operating Temp.	-40 °F to 185 °F (-40 °C to 85 °C)

4. Circuit Breaker

Include a 15 A circuit breaker in the cabinet. The circuit breaker shall have the following characteristics.

Thermal Magnetic 1 pole 120/240 VAC at 50/60 Hz 15 A

Interrupting Rating of 10KA at 48 VDC

Wire Size 14 to 2 AWG

35 MM Din Rail mounting

5. Terminal Block

Include a four position terminal block in the cabinet for making field connections. Properly label all field terminal connections.

6. Construction

Assemble the flasher assembly, terminal block, surge arrestor and circuit breaker in the cabinet as shown on the attached drawing.

Wire all components together as a working unit, thus requiring only field connections to and from the AC power and flashing beacons.

B. Fabrication

Refer to [Subsection 925.2.07.A.1](#) for controller cabinet minimum fabrication specifications.

C. Acceptance

General Provisions 101 through 150.

D. Materials Warranty

Refer to [Subsection 925.2.01.D](#) for Materials Warranties.

925.2.08 Flashing Signal Cabinet With Time Clock

A. Requirements

This specification is for a flashing signal cabinet with time clock which consists of an aluminum cabinet containing a flasher assembly, time clock, field connection terminal block, surge arrestor and circuit breaker wired in a manner to operate school flashing beacons. Refer to [Figure 925-14](#).

1. Cabinet

Supply a NEMA Type 3R cabinet assembly that is manufactured of aluminum with a minimum thickness of 0.125 inches (3 mm).

Ensure that the cabinet exterior has a smooth, uniform natural aluminum finish, and that all joints between adjoining cabinet components (sides and bottom) are continuously welded on the outside to prevent the intrusion of moisture and dust.

Ensure that all welds are free of cracks, blow holes and other irregularities.

The exterior dimensions of the cabinet are as follows:

	<u>Minimum</u>	<u>Maximum</u>
Height	14 inches (350 mm)	18 inches (450 mm)
Width	10 inches (250 mm)	14 inches (350 mm)
Depth	12 inches (300 mm)	16 inches (400mm)

Supply a cabinet door that is double flanged on all four sides to prevent the entry of dirt and liquids when the door is open.

Use a one-piece gasket that is formed around the door opening to insure a weather tight seal when the door is secured.

Attach the door to the cabinet housing with a continuous tamper proof hinge.

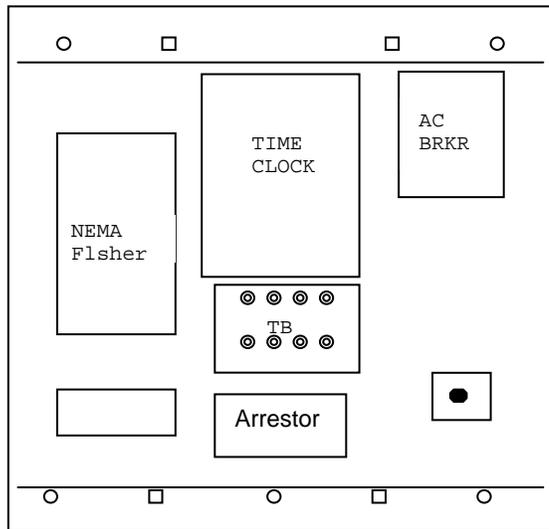
Provide each cabinet with a Corbin #2 lock and one key. Police panel type locks are not acceptable.

Supply each cabinet with an aluminum back panel mounted on standoffs to facilitate mounting of internal components.

Supply cabinets with exterior aluminum mounting brackets, which extend a minimum of 1.75 inches (44 mm) and a maximum of 2.5 inches (63 mm) from the top and bottom of the cabinet.

Use brackets that extend across the full width of the cabinet back on the top and bottom.

Provide these brackets with holes for mounting to a flat surface with screws and vertical slots for banding to steel, concrete or wooden signal poles.



Note: Front view of cabinet Door Assembly not shown No scale

Figure 925-14—Typical Flashing Cabinet with Time Clock Cabinet Layout

2. Flasher Unit

Supply a standard plug in, two circuits NEMA flasher.

Ensure that the flasher is of all solid state construction, meets the requirements of the NEMA Standards and is rated at a minimum of 10 A per circuit.

Ensure that the flasher utilizes zero voltage turn-on and turn-off current and be capable of dimming outputs.

3. Time Switch

Supply a time switch that meets the requirements of [Subsection 925.2.09](#) of this specification.

4. Surge Arrestor

Supply flasher cabinets that incorporate an AC ^{Arrestor} surge arrestor to protect the internal components from lightning and over voltages on the AC service input.

The requirements of the surge arrestor are as follows:

Two Stage Arrestor	
Peak Surge Current	20000 A
Peak Surge Voltage @ 20KA	280 V
Clamp Voltage	280 V @ 20 kA
Continuous AC Voltage	120 V AC RMS
Response Time	<5 nsec
Operating Temp.	-40 °F to 185 °F (-40 °C to 85 °C)

5. Circuit Breaker

Include a 15 A circuit breaker in each cabinet. The circuit breaker shall have the following characteristics.

- Thermal Magnetic 1 pole 120/240 VAC at 50/60 Hz 15 A
- Interrupting Rating of 10KA at 48 VDC
- Wire Size 14 to 2 AWG
- 35 MM Din Rail mounting

6. Terminal Block

Include a four position terminal block in each cabinet for making field connections. Properly label all field terminal connections.

7. Construction

Assemble the flasher assembly, terminal block, surge arrestor and circuit breaker in the cabinet as shown on the attached drawing.

Wire all components together as a working unit, thus requiring only field connections of the AC power and flashing beacons.

B. Fabrication

Refer to [Subsection 925.2.07.A.1](#) for controller cabinet minimum fabrication Specifications.

C. Acceptance

General Provisions 101 through 150.

D. Materials Warranty

Refer to [Subsection 925.2.01.D](#) for Materials Warranties.

925.2.09 Time Clock

A. Requirements

Supply time clocks that are single circuit, calendar programmable, solid state, fully self-contained units (RTC AP 21 or Eltec NTC 17E or equivalent) that meet the following Specifications:

1. Alphanumeric liquid crystal display.
2. Automatic daylight savings time and leap year compensation. Changes in the daylight savings time program made through the keypad do not require hardware modification.
3. Minimum twenty-four (24) hour capacitive back up. Battery back up is not acceptable.
4. Keypad entry programming without the use of any external devices such as a PC, external programming unit, another time switch, etc.
5. Operate on 95 to 135 V AC, 60 Hz line current.
6. SPDT relay output rated at 15 A.
7. Maximum size of 4.25 inches (110 mm) wide, 8.25 inches (210 mm) high and 2 inches (50 mm) deep.
8. A programming manual is to be included with each unit.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

General Provisions 101 through 150.

D. Materials Warranty

Refer to [Subsection 925.2.01.D](#) for Materials Warranties.

925.2.10 Self Tuning Loop Detector

A. Requirements

This specification sets forth the minimum acceptable design, operational and functional performance requirements for multi-channel, inductive loop vehicle detection systems.

1. General Requirements

a. Mounting

Ensure that the unit is configured for rack mount insertion into a NEMA (TS 1 or TS 2) card rack and/or CALTRANS Type 2070 cabinet input file.

b. Environmental

Ensure that the unit is in full compliance with the environmental tests, transient tests and size requirements of NEMA standard TS-1 Section 15, TS-2 Section 6.5 and the California Type 2070 Specifications.

Provide documentation from an independent laboratory, which certifies that the unit is in compliance with the above Specifications.

c. LED Indicator

Ensure that each channel includes two high visibility LED indicators; one for the detect state and the second to indicate the status of the fault monitor.

d. Phase Indicator

Ensure that each channel has an erasable write-on pad to aid in identification of the associated phase or function.

2. Operational Requirements

a. Tuning

Supply units that are fully digital and self-tuning.

Ensure that each channel of the unit can automatically tune to any loop and lead in combination within two (2) seconds of application of power or when a reset signal is received.

Ensure that the tuning circuit is designed so that drift, caused by environmental changes or changes in applied power, does not cause false actuations.

b. Scanning

Supply units that sequentially scan each channel (only one channel energized at any given time) to eliminate crosstalk from multiple loops in adjacent lanes and/or allow overlapped loops for directional control and/or allow use of multi-conductor homerun cable when connected to the same detector unit.

c. Sensitivity Setting

Ensure that each channel is equipped with front panel selectable sensitivity settings in presence and pulse modes.

d. Frequency

Supply units that have a minimum of three switch selectable operating frequencies.

e. Inductance Range

Ensure that each channel can tune to an inductive load from 50 to 2000 microhenries with a Q factor > 5.

f. Grounded Loops

Ensure that each channel can continue to operate with poor quality loop systems ($Q > 2$) including those that have a single point short to ground.

g. Fault Monitoring

Supply units that constantly monitor the operation of each channel.

Ensure that the unit detects shorted loops, open circuit loops or sudden changes in inductance (>25% of nominal).

Ensure that each type of fault is indicated on a fault LED by a unique sequence of flashes until the fault is rectified.

Ensure that while the channel is in the fault condition, the channel output remains in the detect state.

When the fault is rectified, the fault LED continues to emit the sequence signifying the last fault detected, but the detect LED and output returns to normal operation.

h. Failsafe Output

Ensure that each channel output generates a continuous solid state output to the controller when power to the detector is removed.

i. Operational Modes

Supply units with each channel selectable for either pulse or presence modes and that meet the following requirements:

- Pulse Mode

This setting provides a single output pulse (125 ms +/- 25) in response to a vehicle entering the loop.

If a vehicle remains in the sensing zone in excess of two (2) seconds, the unit "tunes out" said vehicle.

The channel is then capable of detecting another vehicle entering the same detection zone.

- Presence Mode

The presence hold time is a minimum of four (4) minutes for small vehicles (motorcycles) and a minimum of sixty (60) minutes for automobiles.

Ensure that the unit tunes out of continuous peak hour traffic over long or multiple small loops as long as there is vehicle motion in the sensing zone every ten (10) minutes.

j. Resets

Ensure that the channels are manually resettable by removing the power momentarily.

Ensure that the channels reset remotely when the voltage on Pin C falls below 8 V DC for a period > 15 μ s, and that the unit resumes normal operation within four (4) seconds after the application of power or after a reset signal of 15 μ s.

k. Field Tuning

Ensure that field adjustments to the operation of the detector do not require the use of a meter, circuit changes, special software or any substitutions, modifications or additions to the unit.

3. Performance Requirements

If testing should be required, provide the Department with a test unit and/or software within ten (10) calendar days of the request.

Should the unit fail to meet the design and/or performance requirements of this specification, the unit will be rejected.

Ensure that the units meet the following requirements:

- a. Capable of detecting passage, holding presence and accurately counting all types of licensed motor vehicles when connected in various loop configurations and lead-in combinations without detecting vehicles in adjacent lanes.
 - **Typical Loop Configurations with Lead-in of 5 feet (1.5 m) to 1,500 feet (1000 m) are:**
 - **6 feet x 6 feet (1.8 m x 1.8 m)**
 - **6 feet x 20 feet (1.8 m x 6 m)**
 - **6 feet x 40 feet [(1.8 m x 12 m) standard or quadrupole]**
- b. Capable of responding to an inductance change of 0.02% and sense vehicles at speeds of up to 80 mph (130 km/h).
- c. Not detect vehicles, moving or stopped, at distances greater than three feet for any loop perimeter.
- d. Detect all vehicles over multiple turn and/or multiple loops that may be connected in series, parallel or series/parallel with homerun lengths from <5 feet (1.5 m) to > 1,500 feet (1,000 m).

4. Optional Features

In addition to the requirements listed in the previous sections, the units may be requested with any combination of the following optional features:

a. Option 1- Timing Features - Delay & Extension

When this option is specified, ensure that the unit incorporates the following features:

1) Delay Timing

Minimum selectable delay time of 1 to 30 seconds in minimum 1-second increments for each channel.

2) Extension Timing

Minimum selectable extension time of 0.5 to 10 seconds in minimum 0.5-second increments for each channel.

b. Option 2 - Advanced Features

When the option for advanced features is specified, supply units that incorporate the following advanced features:

1) Serial Port Interface

When the serial port interface is specified, equip the detector with a front and rear panel RS 232 port for the transmission of data. Provide Windows 95 compatible software for interfacing with the detector.

2) PC Interface

Ensure that PC software, when connected directly to the unit through the front panel RS 232 port, provides a screen to display the following loop system operating characteristics, on a per channel basis, for system setup, data collection and diagnostics.

- Loop Status
- Loop Inductance (μ H)
- Loop Frequency (kHz)

- Inductance Change (nH)
- Last Fault: Open, Shorted, >25% ΔL
- Fault Occurrence: Date & Time
- Vehicle Count

3) Speed, Volume & Occupancy

The software, when connected directly to the unit, is capable of collecting and storing speed, volume and occupancy data from each detector channel.

The software allows assignment of loop-to-loop distances to enable accurate speed and vehicle length measurements.

The speed volume and occupancy information is uploaded and stored in the vendor-supplied software.

Upon request, supply the necessary information/protocols to allow the Department to write custom software to retrieve speed, volume and occupancy data.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

General Provisions 101 through 150.

D. Materials Warranty

Refer to [Subsection 925.2.01.D](#) for Materials Warranties.

925.2.11 Loop Sealant

A. Requirements

Furnish and install loop sealant according to [Subsection 833.2.09, “Polyurethane Sealant for Inductive Loops”](#). For a list of sources, see [QPL 75](#).

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

General Provisions 101 through 150.

D. Materials Warranty

Refer to [Subsection 925.2.01.D](#) for Materials Warranties.

925.2.12 Vehicle Signal Heads

A. Requirements

Supply vehicle signal heads that are 12 inches (300 mm) in diameter for traffic signal control applications. For ramp metering systems supply both 12 inches (300 mm) and 8 inches (200 mm) as per the Plans.

Ensure that the 8 inch (200mm) or 12 inch (300 mm) polycarbonate vehicle signal heads meet the current ITE specification on Vehicle Traffic Control Signal Heads with the following modifications and / or clarifications:

1. Unless otherwise approved by the Engineer or as noted on the Plans, supply signal heads with the following exterior color scheme:
 - Signal Housing - Highway Yellow.
 - Front Face including Doors and Visors: Flat Black
2. Provide housing and housing door that are one piece injection molded ultraviolet and heat stablized polycarbonate resin with the color impregnated in the material.
3. Terminate the wiring from each signal section in the top section of the head assembly. Ensure that the cable jacket is a minimum of 6 inches inside the signal head assembly.
4. Provide the appropriate Vehicle Signal LED Signal in each section either Circular or Arrow Module.

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5. Provide an effective seal with the LED module to make the assembly weather tight.
6. Mount one aluminum reinforcing support plate in the top of the red section of each three, four or five-section signal head for the installation of mounting hardware.
7. Install a support plate between each section of all signal heads. Place these plates such that there is a plate in the bottom of and/or top of any sections where sections adjoin to another section.
8. Provide Signal Heads that use stainless steel hardware and are weather tight. Ensure signal heads that are supplied are sealed for mounting in all possible configurations.
9. Provide Signal Heads that have housing door that “positively” latches using two eyebolts and wing nuts. Ensure the Signal door has hinge lugs molded on one side and two latch jaws are molded on the other side.
10. Provide signal heads that provide a positive method of holding the lens such that the lens does not rotate. Ensure the lens is weather tight. Lens clips which do not apply firm pressure to the lens gasket to avoid rotation are not acceptable. When constructing side by side signal sections ensure that both doors can open at the same time (butterfly). When doors are open ensure that the door will remain attached to housing. Ensure bottom section has drainage holes.

B. Fabrication

Refer to ITE Standards for material composition and finish Specifications.

C. Acceptance

Refer to ITE Standards for material composition, finish Specifications, and wind loading requirements.

D. Materials Warranty

Refer to [Subsection 925.2.01.D](#) for Materials Warranties.

925.2.13 Pedestrian Signal Head

A. Requirements

Provide each section with a visor encompassing the top and sides of the signal face of a size and shape adequate to shield the lens from external lighted sources.

An acceptable option is a “Z-crate” or louver type visor for mounting over the Pedestrian signal face.

Construct the housing of one piece cast aluminum alloy with two integrally hinge lugs, screw slots and openings at each end. Construct the door of one piece cast aluminum alloy with two hinge lugs cast on top of the door and two latch points cast on the bottom. Provide hinge pins of stainless steel to attach the door to the housing and two eye bolts and wing nuts on the other side of the door.

Ensure that the door is provided with a neoprene gasket capable of making a weather resistant, dustproof seal when closed. Supply Pedestrian signal heads with a black face and a yellow body, unless otherwise specified on the Plans.

Ensure that Pedestrian indications are distinguishable to the Pedestrian both day and night and at all distances from 10 feet (3 m) to the full width of the areas to be crossed.

Use symbols that are 12 inches (300 mm) high. Use only internal illumination.

Ensure that when illuminated, the “HAND” symbol is Portland Orange and the “PERSON” symbol is Lunar White, meeting the ITE Standards. Ensure that an opaque material obscures all areas of the face or lens, except for the message. Ensure that when not illuminated, the symbols are not to be distinguishable by Pedestrians at the far end of the crosswalk they control.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

General Provisions 101 through 150.

D. Materials Warranty

Refer to [Subsection 925.2.01.D](#) for Materials Warranties.

925.2.14 Optically Programmed Signal Head

A. Requirements

Supply signal heads that permit the visibility zone of the indication to be determined optically and require no hoods or louvers.

The projected indication may be selectively visible or veiled anywhere within 15 degrees of the optical axis.

Ensure that no indication results from external illumination and that one light unit does not illuminate a second. The components of the optical system include the lamp, lamp collar, optical limiter-diffuser, and objective lens.

Ensure that the optical system accommodates projection of diverse, selected indications to separate portions of the roadway such that only one indication will be simultaneously apparent to any viewer.

Ensure that the projected indication conforms to ITE transmittance and chromaticity Standards.

1. Construction

- a. Provide an LED Lamp Module that is a direct replacement for the incandescent lamp. Ensure the Lamp modules are on the latest CALTRANS QPL for LED Programmed Visibility Modules. Ensure the unit provided operates over the voltage range of 80 to 135 VAC and the temperature range of -40 C (-40 F) to 74 C (165 F). Provide modules that conform to the applicable portions of section 925.2.15. Ensure the unit provides a minimum luminous intensity of 500 candela and does not exceed 18 watts at 25 C (77 F).

Couple the lamp to the diffusing element with a collar including a specular inner surface. The diffusing element may be discrete or integral with the convex surface of the optical limiter.

- b. Supply an optical limiter with an accessible imaging surface at focus on the optical axis for objects 900 to 1,200 feet (270 to 360 m) distance and permit an effective veiling mask to be variously applied as determined by the desired visibility zone.

Ensure that the optical limiter is provided with positive indexing means and is composed of heat-resistant glass.

- c. Ensure that the objective lens is a high-resolution planar incremental lens hermetically sealed within a flat laminate of weather resistant acrylic or approved equal.
Supply a lens that is symmetrical in outline and that may be rotated to any 90-degree orientation about the optical axis without displacing the primary image.

2. Mounting

- a. Supply signals that mount to standard 1.5 inch (38 mm) fittings as a single section, as a multiple section face, or in combination with other signals.

Provide signal sections with an adjustable connection that permits incremental tilting from 0 to 10 degrees above or below the horizontal while maintaining a common vertical axis through couplers and mounting.

Ensure that terminal connections permit external adjustment about the mounting axis in 5-degree increments.

- b. Ensure that the signal is mountable with ordinary tools and capable of being serviced with no tools.

Supply attachments such as back plates or adapters that conform and readily fasten to existing mounting surfaces without affecting water and light integrity of the signal. Supply heads with tri-studs for mounting.

3. Electrical

Supply lamp fixtures that comprise a separately accessible housing and integral lamp support indexed ceramic socket and self-aligning, quick release lamp retainer.

Ensure that electrical connection between case and lamp housing can be accomplished with an interlock assembly, which disconnects lamp holder when opened. Include a covered terminal block for clip or screw attachment of lead wires for each signal section.

Use concealed No. 18 AWG, stranded and coded wires to interconnect all sections to permit field connection within any section.

4. Photo Controls

Ensure that each signal includes integral means for regulating its intensity between limits as a function of the individual background illumination.

Ensure that lamp intensity is not less than 97% of uncontrolled intensity at 10 750 lux, and reduces to 15 + 2% of maximum at less than 10.75 lux.

Ensure that response is proportional and essentially instantaneous to any detectable increase of illumination from darkness to 10 750 lux, and damped for any decrease from 10 750 lux.

Section 925—Traffic Signal Equipment

Ensure that the intensity controller is comprised of an integrated, directional light sensing and regulating device interposed between lamp and line wires.

Ensure that it is compatible with 60 Hz input and responsive within the range 105 to 135 V AC.

Output may be phase controlled, but ensure that the device provides nominal terminal impedance of 1,200 Ω open circuit and a corresponding holding current.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

General Provisions 101 through 150.

D. Materials Warranty

Refer to [Subsection 925.2.01.D](#) for Materials Warranties.

925.2.15 LED Signal Modules

A. Requirements

This specification covers Type 1 Light Emitting Diode (LED) red, green and yellow modules for vehicle signals for both Circular and Arrow indications. It also covers LED Pedestrian “HAND & PERSON” signal modules.

1. General Requirements All Modules

Ensure that Type 1 LED signal module include a LED circuit board with LEDs and required circuit components, 36 inch (900 mm) 16 AWG wire leads with strain relief and spade terminals, a rigid housing, and a one piece neoprene gasket.

Supply Type 1 LED signal modules that are watertight when mounted in the traffic signal housing.

Submit life data on the LEDs from the LED Signal Module manufacturer to calculate the expected useful life.

Supply modules with permanent markings of date of manufacture and date of installation.

Ensure that the Type 1 LED signal modules utilize the same mounting hardware that is used to secure the incandescent lens and gasket assembly.

Provide LED modules that are pixilated (5mm) for all circular indications, arrow indications, and hand and person pedestrian displays.

2. Optical All Modules

Provide test data from an independent laboratory to verify that the performance of the product meets current ITE requirements.

Ensure that the individual LEDs are wired such that a catastrophic failure of one LED will result in the loss of not more than 5% of the signal module light output.

The failure of a single LED in a string or cluster of LED's causes loss of light from only that LED, not the entire string or indication.

Provide control circuitry that prevents the current flow through the LEDs in the “off” state to avoid any false indications as may be perceived by the human eye during daytime and nighttime hours.

Ensure that the LED signal module is operationally compatible with existing or new supplied conflict monitors (NEMA TS-1, NEMA TS-2, Model 210, Model 2010, ITS Cabinet CMU and AMU)..

Ensure that the LED Signal Module is operationally compatible with existing or new supplied load switches.

3. Electrical All Modules

Supply LED signal modules that operate over the temperature range of -40 °F to 165 °F (-40 °C to 74 °C).

Ensure that the power factor is 90% or greater, at nominal rated voltage, at 77 °F (25 °C), after 60 minutes of operation. Provide modules that do not exceed the maximum power consumption as shown in Table 925-18.

Vehicle Indications	Red		Yellow		Green	
Temperature	25 C	74 C	25 C	74 C	25 C	74 C
12 Inch (300 mm) Circular	11	17	22	25	15	15
8 Inch (200 mm) Circular	8	13	13	16	12	12
12 Inch (300 mm) Arrow	9	12	10	12	11	11
Pedestrian Indications	Hand				Man	
Temperature	25 C	74 C	25 C	74 C	25 C	74 C
12 Inch (300 mm)	10	12			9	12

Ensure that the total harmonic distortion (THD) is less than 20% at rated voltage, at 77 °F (25 °C) and that all LED traffic signal modules are in compliance with FCC noise regulations.

Ensure that the LED signal modules operate on line voltage, 120 V AC nominal, and are able to operate over the voltage range of 80 V AC to 135 V AC. Power Supply must be integral to the module.

Provide transient voltage suppression rated at 1,500 W for 1 millisecond and fusing with a maximum rating of 2 A to minimize the effect and repair cost of an extreme over voltage situation or other failure mode.

Ensure the lens of the modules that are polymeric and are not frosted have a surface coating to provide front surface abrasion resistance. Ensure the Red and Yellow section module lens are tinted to correspond with the wavelength (chromaticity) of the LED. Ensure Green Section modules are clear.

Ensure the modules allow a reduction of the intensity of the light output in response to an input from the traffic signal controller. Ensure the minimum light output when dimmed is not less than 30% of the minimum maintained luminous intensity as defined in the applicable Signal Head Module.

4. Circular Signal Modules

Supply LED Circular Signal Modules that fit in standard incandescent vehicle traffic signal housings and meet the Performance Specification of the ITE Vehicle Traffic Control Signal Heads: LED Circular Signal Supplement. In case of conflict, this specification shall govern. Before delivery of any modules supply certification that module is to be in compliance with these specifications. In addition substantiating documentation must be supplied from an independent test laboratory to show the product has passed design qualification testing in accordance with section 6.4 of the ITE Vehicle Traffic Control Signal Heads: LED Circular Signal Supplement. Ensure the report includes a Minimum Maintained Luminous Intensity chart for the module being provided that uses the same horizontal and vertical angles as shown in Table 1 of the ITE Vehicle Traffic Control Signal Heads: LED Circular Signal Supplement. Ensure all modules are provided with a signed copy of the production and test and inspection as detailed in section 6.3 of the ITE Vehicle Traffic Control Signal Heads: LED Circular Signal Supplement.

Supply lenses for that are made of ultraviolet stabilized polycarbonate. Ensure that the external lens surface is smooth, with no raised features, to, minimize the collection of dirt, diesel smoke, and other particulate contaminates, and to facilitate periodic cleaning.

Ensure that Circular Signal Modules have prominent and permanent markings to designate the proper orientation of the signal module in the traffic signal housing. This marking should be an up arrow or the word “UP” or “TOP”.

Ensure Circular Signal Module meets the photometric requirements as indicated and described in the ITE VTCSH LED Circular Signal Supplement.

Supply Red and Yellow LEDs that utilize AllnGap technology, either AS (Absorbing Substrate or TS (Transparent Substrate) and do not exhibit degradation of more than 30% of their initial light intensity following accelerated life testing (operating at 185 F (85 C) and 85% humidity, for 1000 hours). AlGaAs technology is not acceptable.

Supply Green LEDs that utilize gallium nitride technology.

5. Vehicle Arrow Signal Modules

Supply LED Arrow Signal Modules that fit in standard incandescent vehicle traffic signal housings and meet the Performance specification of ITE Vehicle Traffic Control Signal- LED Vehicle Arrow Traffic Signal Supplement.

Ensure that Arrow Signal Modules provided are omni directional and marked as OD so that they may be rotated at any angle. Ensure the Arrow modules Photometrics support the luminous intensity as indicated in table 925-19.

Before delivery of any modules supply certification that module is to be in compliance with these specifications. In addition substantiating documentation must be supplied from an independent test laboratory to show the product has

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passed design qualification testing in accordance with section 6.4 of the ITE Vehicle Traffic Control Signal Heads: LED Circular Signal Supplement. Ensure the report includes a Minimum Maintained Luminous Intensity chart for the module being provided that uses the same horizontal and vertical angles as shown in Table 1 of the ITE Vehicle Traffic Control Signal Heads: LED Vehicle Arrow Traffic Signal Supplement. Ensure all modules are provided with a signed copy of the production and test and inspection as detailed in section 6.3 of the ITE Vehicle Traffic Control Signal Heads: LED Vehicle Arrow Traffic Signal Supplement.

Supply lenses for that are made of ultraviolet stabilized polycarbonate. Ensure that the external lens surface is smooth, with no raised features, to, minimize the collection of dirt, diesel smoke, and other particulate contaminants, and to facilitate periodic cleaning. Supply Red and Yellow LEDs that utilize AllnGap technology, either AS (Absorbing Substrate or TS (Transparent Substrate) and do not exhibit degradation of more than 30% of their initial light intensity following accelerated life testing (operating at 185 F (85 C) and 85% humidity, for 1000 hours). AlGaAs technology is not acceptable.

Supply Green LEDs that utilize gallium nitride technology.

Supply LED Arrow Signal Modules that fit in standard incandescent vehicle traffic signal housings and meet the “ITE Vehicle Traffic Control Signal Heads Part 3: Light Emitting Diode (LED) Vehicle Traffic Signal Modules”. Use Table 925- 19 for all references to minimum maintained Intensity values. Ensure the LED arrow modules meet the required luminous intensity as shown in Table 925-19.

Table 925 - 19 Minimum Maintained Luminous Intensity Values for Arrow LED Indications									
Angle					Angle				
Ver	Hor	12 inch (300 mm)			Ver	Hor	12 inch (300 mm)		
+	+ or -	Red	Yellow	Green	-	+ or -	Red	Yellow	Green
2.5	2.5	56.8	141.6	73.9	2.5	2.5	56.8	141.6	73.9
	7.5	47	117.1	61.1		7.5	47	117.1	61.1
	12.5	32.1	80.1	41.8		12.5	32.1	80.1	41.8
	17.5	18.2	45.3	23.7		17.5	18.2	45.3	23.7
	22.5	8.5	21.2	11.1		22.5	8.5	21.2	11.1
	27.5	3.3	8.2	4.3		27.5	3.3	8.2	4.3
7.5	2.5	47	117.1	61.1	7.5	2.5	47	117.1	61.1
	7.5	38.9	97	50.6		7.5	38.9	97	50.6
	12.5	26.7	66.5	34.7		12.5	26.7	66.5	34.7
	17.5	15.1	37.7	19.7		17.5	15.1	37.7	19.7
	22.5	7.1	17.7	9.2		22.5	7.1	17.7	9.2
	27.5	2.8	6.9	3.6		27.5	2.8	6.9	3.6
12.5	2.5	32.1	80.1	41.8	12.5	2.5	32.1	80.1	41.8
	7.5	26.7	66.5	34.7		7.5	26.7	66.5	34.7
	12.5	18.3	45.7	23.9		12.5	18.3	45.7	23.9
	17.5	10.5	26.1	13.6		17.5	10.5	26.1	13.6
	22.5	5.0	12.4	6.4		22.5	5.0	12.4	6.4
	27.5	-	-	-		27.5	-	-	-
17.5	2.5	18.2	45.3	23.7	17.5	2.5	18.2	45.3	23.7
	7.5	15.1	37.7	19.7		7.5	15.1	37.7	19.7
	12.5	10.5	26.1	13.6		12.5	10.5	26.1	13.6
	17.5	6.0	15.0	7.8		17.5	6.0	15.0	7.8
	22.5	2.9	7.2	3.8		22.5	2.9	7.2	3.8
	27.5	-	-	-		27.5	-	-	-
22.5	2.5	8.5	21.2	11.1	22.5	2.5	8.5	21.2	11.1
	7.5	7.1	17.7	9.2		7.5	7.1	17.7	9.2
	12.5	5.0	12.4	6.4		12.5	5.0	12.4	6.4
	17.5	2.9	7.2	2.8		17.5	2.9	7.2	2.8
	22.5	-	-	-		22.5	-	-	-
	27.5	-	-	-		27.5	-	-	-
27.5	2.5	3.3	8.2	4.3	27.5	2.5	3.3	8.2	4.3
	7.5	2.8	6.9	3.6		7.5	2.8	6.9	3.6
	12.5	-	-	-		12.5	-	-	-
	17.5	-	-	-		17.5	-	-	-
	22.5	-	-	-		22.5	-	-	-
	27.5	-	-	-		27.5	-	-	-

6. Pedestrian Signal Modules

Supply LED Pedestrian Traffic Signal Modules that fit in standard pedestrian one section signal head manufactured in accordance with the ITE Pedestrian Traffic Control Signal Indications (PTCSI) housings and meet the ITE Pedestrian Traffic Signal Modules specification.

Ensure that the Pedestrian Indications for the “Hand” and “Man” are filled in so as to provide a solid indication. Do not supply Pedestrian Indications for the Hand and Man that are “outlines”.

Ensure that Pedestrian Signal Modules have prominent and permanent markings to designate the proper orientation of the signal module in the pedestrian signal housing. This marking should be an up arrow or the word “UP” or “TOP”.

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Ensure Pedestrian Signal Module meets the photometric requirements as indicated and described in the ITE PTCSI LED Pedestrian Traffic Signal Module Specification.

Supply Portland Orange LEDs that utilize AlInGaP technology, either AS (Absorbing Substrate) or TS (Transparent Substrate) and do not exhibit degradation of more than 30% of their initial light intensity following accelerated life testing (operating at 185 F (85 C) and 85% humidity, for 1000 hours). AlGaAs technology is not acceptable.

Supply White LEDs that utilize InGaN technology.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

General Provisions 101 through 150.

D. Materials Warranty

Ensure that LED traffic signal modules and LED Pedestrian modules are performance warranted to be in compliance with the minimum intensity values as shown in Table 925-19. Provide independent laboratory test results indicating that LED indications satisfy the minimum intensity Standards for LED traffic signal modules, measured at 120 V AC and 165 °F (74 °C), for a period of five (5) years.

Ensure that the manufacturer's name, part number, date code, and electrical characteristics of the LED signal module is visible on the assembly, and that each LED signal module is identified for warranty purposes.

925.2.16 LED Pedestrian and Countdown Signal Module

A. Requirements

This specification covers LED traffic signal module designed as a retrofit replacement for the message bearing surface of nominal 16" x 18" traffic signal housing built to the PTSCI Standard. The message bearing surface of the module consists of an overlapping "Hand" and "Man" Symbols with a numerical display of numbers from 00 to 99.

1. General Requirements

Ensure that the unit supplied meets the applicable portions of section 925.15 of this specification.

Ensure that the message numbers "00" to "99" are a minimum of 9 inches in height and consist of two rows of LEDs.

Ensure the module fits in the Pedestrian Signal Housing without modification to the housing and requires no special tools for installation.

Supply LED signal modules that are watertight when mounted in the traffic signal housing.

Supply life data from the LED Signal Module manufacturer to calculate the expected useful life

Supply modules with permanent markings for date of manufacture and date of installation.

2. Optical

Provide test data from an independent laboratory to verify that the performance of the product meets current ITE requirements.

Ensure that the individual LEDs are wired such that a catastrophic failure of one LED will result in the loss of not more than 5% of the signal module light output.

The failure of a single LED in a string causes loss of light from only that LED, not the entire string or indication.

Provide control circuitry that prevents the current flow through the LEDs in the "off" state to avoid any false indications as may be perceived by the human eye during daytime and nighttime hours.

Ensure that the LED signal module is operationally compatible with existing or new supplied conflict monitors (NEMA TS-1, NEMA TS-2, Model 210, Model 2010, ITS Cabinet CMU and AMU).

Ensure that the LED Signal Module is operationally compatible with existing or new supplied load switches.

Ensure that the intensity of the LED signal module does not vary by more than 10% over the allowable voltage range as specified in the electrical section below.

Ensure that the LED signal modules maintain not less than 90% of the required intensity, as defined by the ITE intensity Standards for LED traffic signal modules.

Ensure that each module provides an average luminous of at least 3750 candela per square meter of lighting surface for the “Hand” and 5300 candela per square meter for the Man symbol.

Ensure this over the temperature range of –40 °F to 165 °F (–40 °C to + 74 °C) at 120 V AC, when new and after four (4) years of field installation.

Provide an exterior lens which is uniform and frosted to reduce sun phantom effect.

3. Electrical

Supply LED signal modules that operate over the temperature range of –40 °F to 165 °F (–40 °C to 74 °C).

Ensure that the power factor is 90% or greater, at nominal rated voltage, at 77 °F (25 °C), after 60 minutes of operation.

Ensure that the total harmonic distortion (THD) is less than 20% at rated voltage, at 77 °F (25 °C) and that all LED traffic signal modules are in compliance with FCC noise regulations.

Ensure that the LED signal modules operate on line voltage, 120 V AC nominal, and are able to operate over the voltage range of 80 V AC to 135 V AC.

Provide transient voltage suppression rated at 1,500 W for 1 millisecond and fusing with a maximum rating of 2 A to minimize the effect and repair cost of an extreme over voltage situation or other failure mode.

Ensure the modules allow a reduction of the intensity of the light output in response to an input from the traffic signal controller. Ensure the minimum light output when dimmed is not less than 30% of the minimum maintained luminous intensity as defined in the applicable ITE Signal Head Module.

4. Operation

Supply LED Modules which start counting when the flashing “Don Walk” Indication starts and will countdown to “0” when the steady “Don’t Walk” signal turns on. Ensure that the unit maintains a consistent countdown during a short power failure (i.e. Traffic Controller does not restart). Ensure that if Traffic Controller restarts that the countdown timer display is turned off until one full pedestrian clearance Cycle is timed. Ensure that the unit will turn off the counter if the steady Don’t Walk Display starts while the countdown timer is displaying a number other than 00.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

General Provisions 101 through 150.

D. Materials Warranty

Ensure that LED traffic signal modules and LED Pedestrian modules are performance warranted to be in compliance with the latest ITE and CALTRANS minimum intensity Standards for LED traffic signal modules, measured at 120 V AC and 165 °F (74 °C), for a period of five (5) years.

Ensure that the manufacturer’s name, part number, date code, and electrical characteristics of the LED signal module is visible on the assembly, and that each LED signal module is identified for warranty purposes.

925.2.17 Blank-Out Signs

A. Requirements

Ensure that each sign provides a clearly visible and definable legend for 500 feet with ample safety factors.

Provide hardware to mount the sign on standard 1.5 inch (38 mm) pipe brackets or to mount directly to signal mast arms or span wire or as outlined in the Plans.

Ensure LED blankout signs conform to the requirements of section 925.2.15 for LED modules and optical requirements

Supply blank-out signs face 30 inches x 36 inches (750 mm x 900 mm) that are capable of displaying one message at a time in one direction.

1. Case

Use a case formed from aluminum extrusion F1-6-E and a special aluminum door frame angle.

For Alloy 6063-T5, ensure that the wall is at least 0.075 inches thick and the corners and joints are at least 0.080 inches (2 mm) thick.

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Use filler arc for all welding. Ensure all hinges and fastening hardware, nuts, bolts, fasteners on the housing and internal components are stainless steel

Use a BR-type take-apart door hinge and draw bolt. Furnish one P-15 1.5 inch (38 mm) hub on the top surface.

Prime the entire case with zinc chromate, bake the inside with two coats of non-yellowing white, and paint the outside with two coats of highway yellow.

2. Electrical

Ensure that all blankout signs are LED and conform to current ITE Standards. Supply all signs with the necessary mounting hardware to provide for mounting as shown on the Plans. Provide mounting for one way or two way configurations.

Obtain approval for messages and letter dimensions from the Engineer.

3. Sun Phantom Screen

Attach to each sign a heavy-duty aluminum louver-type sun phantom screen covering the entire sign face. Slant the louvers down enough to eliminate the sun glare without obstructing the view of the sign face.

4. Painting

Paint the signal surfaces, inside and out, with two coats of oven-baked enamel in addition to the primer coat. Paint the non-illuminated portions of the signal face black. Paint the housings, brackets, fittings, and etc. highway yellow.

5. Lens

Use a fabricated, three-section Plexiglas lens clear face, with or without legend, which can accept a silk-screened legend on the first surface. Provide a thickness of at least 0.31 inches (8 mm).

6. Legend

Acceptable legends are as follows:

Text:

- NO LEFT TURN
- NO RIGHT TURN
- SIGNAL AHEAD
- NO TURNS

Symbols:

- NO LEFT TURN SYMBOL
- NO RIGHT TURN SYMBOL

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

General Provisions 101 through 150.

D. Materials Warranty

Refer to [Subsection 925.2.01.D](#) for Materials Warranties.

925.2.18 Lane-Use Control Signal

A. Requirements

Ensure that all signals are LED and conform to current ITE Standards. Supply all signals with the necessary mounting hardware to provide for mounting as shown on the Plans. Provide mounting for one way or two way configurations.

1. General Requirements

a. Weight

Ensure that one-way units weigh not more than 50 pounds (23 kg) and two-way units weigh not more than 60 pounds (27 kg), regardless of messages.

b. Color

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Ensure that the color of lane-use control signal indications is clearly visible for 0.25 mile (0.38 km) at all times under normal atmospheric conditions. Provide lane-use control signals with a visibility angle of a minimum of 60 degrees.

c. Housing

Ensure that the housing of each signal is polycarbonate or a one-piece corrosion resistant aluminum alloy die casting or equal and meets current related ASTM Specifications.

Ensure that all configurations are balanced to provide a plumb hanging unit. Ensure that all components are readily and easily accessible from the open door.

d. Housing door

Ensure that the housing door is one-piece corrosion resistant aluminum or polycarbonate and meets current related ASTM Specifications.

Provide two substantial door hinges with stainless steel hinge pins. Ensure hinges are on the left side of each section with a latch boss on the right side.

Provide stainless steel dual eye bolt latches or similar approved devices to securely close and latch the housing door. Equip the housing or door with a continuous molded neoprene gasket to make the interior of the unit dustproof and waterproof.

e. Wiring

Provide each signal housing with a complete terminal board. Ensure that one side of terminal strip accommodates socket leads and the other side accommodates field wires. Ensure that the terminal board provides totally separate wiring of each symbol.

Ensure each lamp is separately wired to a terminal block located in each housing. Provide each lamp holder socket with color-coded leads.

For combination symbols, color-code socket leads separately to distinguish between red "X", yellow "X" or downward arrow symbols. Provide leads that are No. 14 AWG type THW, 600 V AC, and fixture wire with 194 °F (90 °C) thermoplastic insulation.

f. Visors

Provide visors not less than 12 inches (300 mm) long for multiple unit and 7 inches (175 mm) long for single unit signals for each signal face.

Ensure that the visors are constructed of sheet aluminum or polycarbonate and encompass the top and sides of each section.

g. Painting

Paint all signal surfaces, inside and out, with two coats of oven baked enamel in addition to the primer coat. Paint the insides of the visors flat black.

The non-illuminated portions of the signal face black or dark gray and all housings, brackets and fittings highway yellow.

h. Hardware and fittings:

Supply all necessary fittings, pipe brackets, hangers, hubs, etc. for the type of mounting specified. Ensure all fittings are aluminum or galvanized coated to prevent rust and corrosion.

i. Sun -phantom screen

Provide each signal face with a screen, which substantially counteracts sun phantom effect.

2. Signal Display

Ensure that the symbols, which are on an opaque black or dark gray background, meet ITE requirements and are blacked out when not illuminated.

3. LED Optical System

a. Ensure that the LEDs supplied for the lane use control signal meet the Specifications for a type module as required in section 925.2.14. Ensure that each separate color indication in a sign face is illuminated by independent LEDs

b. Ensure that the green arrow indication does not utilize the same termination points as any "X" indication.

c. Ensure that total power required for any single indication does not exceed 250 W.

d. Ensure that all modules are contained behind a water tight signal face or lens assembly.

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- e. Ensure that the entire optical system is weatherproof and is not vulnerable to extremes in temperature or moisture.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

General Provisions 101 through 150.

D. Materials Warranty

Refer to [Subsection 925.2.01.D](#) for Materials Warranties.

925.2.19 Pedestrian Push Button Station

A. Requirements

Ensure that Pedestrian push buttons are of tamperproof construction and consist of a direct push type button and single momentary contact switch in cast aluminum housing. The pushbutton cover shall also be of cast aluminum. The housing and cover shall be free of voids, pits, dents, molding sand excessive foundry grinding marks. Exterior surface shall be smooth and cosmetically acceptable, free of molding fins, cracks and other exterior blemishes.

Provide housing and cover with an alodine conversion coating so as to provide a proper base for paint adhesion. Finish the housing with baked enamel and paint the push button housing and Pedestrian heads highway yellow (unless otherwise specified by the Engineer).

The assembly shall be capable of being mounted to a flat or curved surface. Ensure the assembly includes the appropriate sign as shown in the Plan Details.

Ensure that any screws or bolts are stainless steel and vandal proof. Provide the unit with a 0.5 inch (13 mm) threaded opening with plug.

Ensure that the assembly is weatherproof and so constructed that when properly installed, it will be impossible to receive an electrical shock under any weather condition.

Ensure that Pedestrian Pushbuttons are integrated with a sign as shown in the standard details. Provide the sign size as indicated on the Plans. GDOT will allow an adapter of cast aluminum. GDOT will allow one of three options:

1. The use of a 9 inch (229 mm) by 15 inch (381 mm) cast aluminum plate adapter to upgrade existing push button station, 9 inch (229 mm) by 12 inch (305 mm).
2. Push button station assembly 9 inch (229 mm) by 15 inch (381 mm) sign w/round pushbutton adapter.
3. The use of a 9 inch (229 mm) by 15 inch (381 mm) cast aluminum plate adapter to upgrade existing push button station, 5 inch (127 mm) by 7 inch (178 mm).

Ensure that the Pedestrian Push Button sign adapter plate is, die-cast aluminum and separate, such that it is interchangeable.

Ensure that the Pedestrian Push Button sign adapter assembly be, die-cast aluminum and attached, prior to shipping.

The plate shall be finished with highway yellow baked enamel paint (unless otherwise specified by the Engineer).

Ensure the button assembly is configured to be a mechanical switch with ball and 2 inch mushroom plunger.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

General Provisions 101 through 150.

D. Materials Warranty

Refer to [Subsection 925.2.01D](#) for Materials Warranties.

925.2.20 Signal Head Back Plate

A. Requirements

Ensure that each back plate is designed to properly shield a traffic signal head from background distractions for better visibility.

Design the back plates to extend beyond the signal head to a minimum of 6 inches (150 mm) on all sides and have all corners rounded with minimum 2 inch (50 mm) radii.

Construct the back plates from; UV stabilized polycarbonate or, ABS plastic material with a finished color of flat black. Ensure that polycarbonate back plates are at least 0.15 inches (4 mm) thick; ABS back plates are at least 0.05 inches (1 mm) thick and metal back plates are at least 0.05 inches (1 mm) thick.

Design the back plates with predrilled holes to provide for simple attachment to the specified brand, size and configuration of traffic signal head with all mounting hardware included.

Ensure that the back plates do not interfere with the signal mounting hardware. Ensure that the back plates include louvers.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

General Provisions 101 through 150.

D. Materials Warranty

Refer to [Subsection 925.2.01.D](#) for Materials Warranties.

925.2.21 Signal Head Visors

A. Requirements

Typically, visors are one piece tunnel type and removable unless specified otherwise in the signal Plans.

Ensure that visors are polycarbonate and at least 9 inches (225 mm) deep for 12 inch (300 mm) heads. Special angle visors are full circle with the long side at least 18 inches (450 mm) deep. Ensure that visors provide a positive method of attaching to the door of the signal head that do not allow rotation. An acceptable method is to provide tabs that use stainless steel screws.

Unless otherwise specified by the Engineer, provide black signal head visors.

If special tools are required for louver adjustment one shall be provided per project.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

General Provisions 101 through 150.

D. Materials Warranty

Refer to [Subsection 925.2.01.D](#) for Materials Warranties.

925.2.22 Signal Head Louvers

A. Requirements

Ensure that louvers (with the vanes oriented vertically) are directional with a 7-degree cutoff right of center. Rotating the louver 180 degrees will produce a 7-degree cutoff left of center.

Provide twelve-inch (300 mm) louvers with 5 vanes. Finish all louvered surfaces in flat black. Ensure that programmable louvers are directional with a 7-degree cutoff and that all louver surfaces have a flat black finish.

Ensure that the units can be installed and programmed in accordance with the manufacturer's instruction on visors that are recommended by the manufacturer.

Have the programmable louver display approved by the Engineer prior to placing the signal in stop and go operation.

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B. Fabrication

General Provisions 101 through 150.

C. Acceptance

General Provisions 101 through 150.

D. Materials Warranty

Refer to [Subsection 925.2.01.D](#) for Materials Warranties.

925.2.23 Hardware For Mast Arm Mounting

A. Requirements

1. Ensure that signal heads are rigidly mounted to the mast arm. Provide mounting hardware that is in accordance with the following:Adjustability
Ensure the mounting bracket is completely adjustable such that it allows; rotational adjustment about the bracket axis; vertical adjustment; rotational adjustment about the Mast Arm; and rotational adjustment from the vertical plane.
2. Attachment
Ensure the bracket is provided with air-craft grade galvanized steel cables with stainless steel fastening hardware and make a minimum of two wraps around to fasten the bracket to the arm. Ensure the bracket is easily adjustable to fit all sizes of round, elliptical or other shaped structure without special tools or equipment.
3. Signal/Sign Accomodations
Ensure the bracket attaches to the signal or sign to assure maximum rigidity. When clamping the signal top and bottom, ensure a standard bracket accommodates all major signal manufacturers signal for 3, 4 and 5 section signal head configurations.
4. Wiring
All electrical wiring shall be completely concealed with the bracket. The vertical support shall be a gusseted “C” shaped extruded aluminum tube to accommodate the signal cable regardless of vertical positioning of the tube.
5. Materials
The upper and lower arms shall be cast 319 aluminum or equivalent. The lower arm shall be internally threaded to accommodate the threaded vertical support tube. Ensure the lower arm is furnished with plastic covers which slide and snap into place. Both arms shall have 72 tooth serrations cast into the arm to assure a positive lock with signal housing and shall be secured about their rotational axis with setscrews. Ensure the arms have a tri-bolt arrangement for attachment to the signal housing.
Ensure the vertical support is gusseted tube extruded from 6063-T6 aluminum. Ensure the tube includes a vinyl closure strip.
Ensure the mast arm clamp assembly is cast from 713 aluminum alloy or equivalent. Provide an assembly that allows for 360 degrees of rotation with no internal bracing obstructing the center opening. Provide two air-craft grade galvanized steel cables that have minimum tensile strength of 100,000 PSI.
Ensure that each bracket is complete with all necessary bolt, washers, gaskets and miscellaneous items to allow assembly of the signal to the bracket and the bracket to the mast arm. Ensure all aluminum parts have an Aldine finish. All non stainless steel parts shall have a yellow zinc di-chromate or galvanize finish.

This item will be approved upon submittal of catalog cuts. Refer to Standard Detail Drawings for additional information.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

General Provisions 101 through 150.

D. Materials Warranty

Refer to [Subsection 925.2.01D](#) for Materials Warranties.

925.2.24 Hardware For Signal Head Pole Mounting

A. Requirements

Ensure this item consists of hardware adequate for the specific mounting. As a minimum provide the following hardware. 1 ½ inch pipe nipples of die cast aluminum that are a minimum of 12 inches and threaded with 1 ½ inch NPS threads on either end. On the upper and lower arm there shall be a serrated 72 tooth boss with set screw. The upper arm shall have a neoprene gasket to provide weather tight fit. Hub plates for pole mounting shall be provided and they shall be appropriate for the particular mounting (round or flat). Hardware shall die cast aluminum alloy 380 or extruded. All die cast parts shall be cleaned in an alkaline cleaning compound Extruded parts shall have an alodine conversion coating to provide proper base for paint adhesion. The assembly is to be painted federal yellow and baked in an oven. Ensure the assembly is provided with all required hardware. All other hardware shall be stainless steel.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

Ensure that this item consists of hardware as shown in the standard details.

This item will be approved upon submittal of catalog cuts.

D. Materials Warranty

Refer to [Subsection 925.2.01.D](#) for Materials Warranties.

925.2.25 Balance Adjuster

A. Requirements

Ensure this item consists of hardware that is cast from 316 Stainless Steel or 65-45-12 Ductile Iron or equivalent. Ensure castings are free of voids, pits, dents, molding sand and excessive grinding marks. Exterior surface shall be cosmetically acceptable and free of molding fins, cracks and other exterior blemishes. All hardware shall be supplied and be stainless steel or galvanized.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

Ensure this item consists of hardware as shown in the Standard Details. This item will be approved upon submittal of catalog cuts.

D. Materials Warranty

Refer to [Subsection 925.2.01.D](#) for Materials Warranties.

925.2.26 Hardware For Mounting 12 Inch (300 mm) Pedestrian Head

A. Requirements

Ensure this item meets the same criteria as 925.2.24.A and is in accordance with the Standard Details.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

Ensure this item consists of hardware as shown in the Standard Details. This item will be approved upon submittal of catalog cuts.

D. Materials Warranty

Refer to [Subsection 925.2.01.D](#) for Materials Warranties.

925.2.27 Pedestal Pole

A. Requirements

The Pedestal poles support vehicle signal heads, pedestrian signal heads, IVDS and push button. Furnish Pedestal poles according to type and overall length.

Pedestal pole for vehicle display for one lane ramp metering operation shall be constructed to support one 12” signal head and one 8” signal head assembly as shown in the Plans.

Pedestal pole for ramp meter advance warning sign and flashing beacon shall be constructed to meet the sign manufacturer’s structural requirements. Pedestal pole mounting adapter shall rigidly attach to the sign case’s structural bracing. Cable entrance to the sign case shall be through the inside of the pole.

Ensure that all poles are made of one continuous piece of bare finish spun aluminum from top to base connection for the entire height of the pole.

The shaft, of appropriate shape, may or may not be uniformly tapered from butt to tip. A pole used to support only a traffic signal may be tapered.

Fabricate pole caps, when required, of cast material, and secure in place with set-screws.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

General Provisions 101 through 150.

D. Materials Warranty

Refer to [Subsection 925.2.01.D](#) for Materials Warranties.

925.2.28 Pedestal Pole Base

A. Requirements

Ensure that all design radii are smooth and intact. Ensure that the exterior surface finish is smooth and cosmetically acceptable by being free of molding fins, cracks and other exterior blemishes.

Fabricate from new aluminum ingot. Do not use scrap materials.

Minimum requirements are as follows:

• ALUMINUM ALLOY NO.	319	ELONGATION [% IN 2 IN. (50 mm)]	2.5
• TENSILE STRENGTH, KSI (MPa)	34 (234)	BRINELL HARDNESS	85
• YEILD STRENGTH, KSI (MPa)	19 (131)	SHEAR STRENGTH, KSI (MPa)	232 (1600)

1. Ensure this item consists of square cast aluminum with bare finish, and has a minimum weight of 21 pounds (9.5 kg). Thread the upper end to receive a 4 inch (100 mm) National Pipe Thread (NPT) pipe shaft.
2. Design the base so that it may be fastened to a foundation with four (4) 0.75 inch (19 mm) anchor bolts located 90 degrees apart on the bottom of the base. Provide slots in the bottom of the base 1.5 inch (38 mm) wide and 2.5 inches (63 mm) long measured along the circumference of the bolt circle, allowing a proper fit even if the bolts are placed slightly off center.
3. Design the base to accommodate bolt circles of a minimum of 12 inches (300 mm) through a maximum of 14.5 inches (363 mm) and anchor bolts with a minimum of 0.63 inches (16 mm) through 1 inch (25 mm) diameter.
4. Design the base with a removable plastic door. Ensure that the door opening is free of burrs and sharp edges and is no less than 8.5 inches (213 mm) square. Attach the door to the base using one socket button head screw to prevent unauthorized entry.
5. Ensure that the base meets or exceeds current AASHTO breakaway requirements. Provide test reports from an FHWA approved independent laboratory certifying that the base has been tested and meets all applicable requirements. In addition, supply a statement of certification from the FHWA stating such tests have been accepted and approved.
6. In order to prove structural soundness, provide a certification from a recognized independent structural laboratory certifying that the base will withstand a bending moment of 10,750 ft-lbs (14 575 N-m).

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7. Ensure that the door is injection molded from ABS plastic to deter vandalism and theft, and has the following properties:

<u>TEST</u>	<u>ASTM METHOD</u>	<u>VALUE</u>
Tensile @ Yield [0.13 inches (3 mm)]	D638	6600 psi (45 500 kPa)
Flexural @ Yield	D790	11,000 psi (75 850 kPa)
Rockwell Hardness	D785	101 (R Scale)
Notched Izod	D256	5 ft-lb./in. (0.03 N-m/mm)

8. Ensure that the door exhibits the following properties:

- Has an edge thickness of 0.25 inches (6 mm) and a minimum thickness of 0.156 inches (4 mm)
- Contains flame-retardant material, meeting or exceeding underwriters laboratories UL 94 test H.B
- Gray aluminum tone in color, unless otherwise specified
- Contains ultra-violet inhibitors and stabilizers for protection against UV degradation
- Is injection molded with a smooth front finish
- Has flat and straight surfaces without blisters, buckling or warping; have reinforcing ribs
- Contains two (2) injection molded lugs on the bottom of the door with slots of the proper width and depth to fit the base door opening.

9. Supply the base with a set of four (4) anchor bolts, 0.75 inch (19 mm) diameter by 18 inches (450 mm) in length, material per ASTM A 572A 572M, Galvanized per ASTM A 153/A 153M. Supply (1) hex nut and (1) flat washer with each bolt.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

General Provisions 101 through 150.

D. Materials Warranty

General Provisions 101 through 150.

925.2.29 Pedestal Pole Foundation Anchor Assembly

A. Requirements

Provide Foundation Anchor assembly that is 4 inches (100 mm) in diameter by 56 inches (1400 mm) with a single helical blade and a square fixed baseplate with combination underside holt-head retainer and dirt scrappers allowing flush- mount with the ground.

Provide Baseplate that is steel and conforms to ASTM A-36 material. Provide pipe with helical blade that is manufactured from ASTM A-53ERW Grade B Steel. Ensure 4 inch pipe has 2 inch (50 mm) by 3 inch (75mm) entrance hole 18 inches below the steel plate. Ensure the anchor assembly is hot dipped galvanized finish after fabrication and complies with ASTM A-123.

Ensure base plate has four slotted mounting holes to fit bolt circles from 7 ¾ inch (195mm) to 14 ¾ inch (375 mm). Provide 4 slotted mounting hole with a ¾ inch keyhole slot to permit bolt installation and replacement from the top surface without digging under the baseplate.

Ensure assembly is furnished with;

- Quantity of four ¾ inch(20 mm) -10NC x 3 inch(75 mm) square head galvanized ASTM 325 anchor bolts;
- Quantity of four ¾ inch(20 mm) plain flat galvanized washers;
- Quantity of four 3/16 inch(5 mm) thick galvanized plate washers;
- and Quantity of four ¾ inch (20 mm) galvanized hex nuts.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

General Provisions 101 through 150.

D. Materials Warranty

Refer to [Subsection 925.2.01.D](#) for Materials Warranties.

925.2.30 Timber Poles

A. Requirements

Ensure that all timber poles meet the requirements of [Section 861](#). Poles must be inspected and tested by the GDOT Office of Materials and Research and hammer stamped by the inspector.

Ensure that all poles have a brand or stamp 10 feet (3 m) from the butt that notes the type wood, date of manufacture, manufacturer, class and length.

Ensure that all timber poles that have guy attachments or support span wire or arms that suspend signal heads over the roadway or sidewalk are Class II.

Poles that support loop lead-in, messenger or communications cable that does not have guy attachments may be Class IV size.

Ensure that all poles meet the requirements in the table below unless otherwise noted on the traffic signal Plans or list of materials.

Class	Nominal Length, ft (m)	Minimum Circumference
		At 6 feet (2.4 m) from butt, in. (mm)
II	30 (9)	34.0 (850)
II	35 (10.5)	36.5 (913)
II	40 (12)	38.5 (963)
II	45 (13.5)	40.5 (1013)
II	50 (15)	42.0 (1050)
IV	30 (9)	29.5 (738)
IV	35 (10.5)	31.5 (788)
IV	40 (12)	33.5 (838)

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

General Provisions 101 through 150.

D. Materials Warranty

Refer to [Subsection 925.2.01.D](#) for Materials Warranties.

925.2.31 Steel Strain Poles

A. Requirements

Ensure that steel strain poles conform to [Section 639](#) and include hardware for span wire attachments, anchor base, and anchor bolts for the purpose of supporting span wire suspended signs and/or signals.

For signal supports, ensure that the opening at the top and bottom of the pole is large enough to allow all wiring into and out of pole. Do not strap conduit to strain pole because of insufficient opening allowances.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

General Provisions 101 through 150.

D. Materials Warranty

Refer to [Subsection 925.2.01.D](#) for Materials Warranties.

925.2.32 Pre-Stressed Concrete Strain Pole

A. Requirements

Ensure that Pre-stressed concrete strain poles for overhead signs and signal supports conform to [Section 500](#).

For signal supports, ensure that the opening at the top and bottom of the pole is large enough to allow all wiring into and out of pole. Do not strap conduit to strain pole because of insufficient opening allowances.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

General Provisions 101 through 150.

D. Materials Warranty

Refer to [Subsection 925.2.01.D](#) for Materials Warranties.

925.2.33 Traffic Signal Pull Box

A. Requirements

Ensure that traffic signal pull boxes a matched assembly of a box and cover from the same manufacturer.

For all pull boxes except Types 4 and 5, use pull boxes manufactured in a single unit for the full depth required in the size in an open bottom configuration. Do not use stacked pull boxes.

For pull boxes Types 4 and 5, use stacked pull boxes as shown in the Plans, where the top unit is open bottom and the bottom unit is closed bottom manufacture. In the bottom unit provide a drain hole.

Provide pull boxes that are constructed of fiberglass-reinforced composite polymer concrete product or steel wire reinforced portland cement concrete product with a concrete gray or tan color.

Ensure that pull boxes meet all requirements of ANSI 77 2002 Tier 15. Provide compliance test documentation.

Provide a ¼-inch galvanized wire mesh between the gravel base and the open bottom box or closed bottom box drain hole for all pull box types.

Use Type 1 pull boxes [12 inches x 12 inches (300 mm x 300 mm)] for loop lead-ins. When loop lead-ins and splices and other cables are required, use Type 2 pull boxes [11 inches x 18 inches (275 mm x 450 mm)] or Type 3 pull boxes [17 inches x 30 inches (425 mm x 750 mm)]. Use Type 4, 4S, 5, 5S, 6 and 7 pull boxes for fiber optic cable. Furnish one-piece covers for all pull boxes except Types 5, 5S, and 7. Furnish two-piece covers for Types 5, 5S, and 7.

Furnish covers with a skid-resistant surface with a minimum coefficient of friction of 0.5 when tested in accordance with ASTM C1028.

Furnish covers with stainless steel hold-down bolts, minimum size 3/8-16.

Furnish covers with the logo “TRAFFIC SIGNAL” for pull box Types 1, 2 and 3, and with other pull box types when installed for traffic signal cabling at a traffic signal.

Unless otherwise shown in the Plans or installed for traffic signal cabling at a traffic signal, furnish covers with the logo “GDOT COMMUNICATIONS” for pull box Types 4, 4S, 5, 5S, 6 and 7.

Furnish pull box Types 4, 5, 6 and 7 with factory-installed cable racks and rack hooks.

Cable racks and rack hooks shall be hot-dipped galvanized steel.

Each cable rack rail shall be minimum 24 inches (600 mm) in length with rack hook mounting holes on the entire length. Install two racks on each of the pull box long side walls. For Type 4 and 5 pull boxes only, each cable rack rail may be comprised of two minimum 12 inch (300 mm) units installed on the stacked box side walls.

Mount cable racks to the side walls using minimum 3/8-16 stainless steel hardware.

Furnish a minimum of four rack hooks, minimum 6 inch length (150 mm), per pull box. Furnish an additional four rack hooks for each through cable stored in the pull box. Furnish an additional two rack hooks for each splice closure stored in the pull box.

Furnish Types 6 and 7 pull boxes with factory-installed non-metallic conduit terminators for Sch. 40 and SDR11 2-inch (53 mm) of the quantity and location as shown in the Plans, or for a different conduit size if shown in the Plans.

Terminator bodies shall be manufactured from high-impact polystyrene or approved equivalent.

When joining conduits of dissimilar materials, furnish an airtight and watertight conduit adhesive intended for direct-contact underground use.

Refer to the Standard Detail Drawings and the Traffic Signal Design Manual for further information.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

General Provisions 101 through 150.

D. Materials Warranty

Refer to [Subsection 925.2.01.D](#) for Materials Warranties.

925.2.34 Prefabricated Controller Cabinet Base

A. Requirements

Provide controller cabinet bases that are precast polymer concrete and grey in color. Ensure the prefabricated controller cabinet base has the correct bolt pattern for the cabinet(s) to be installed. Provide prefabricated controller cabinet bases with UNC inserts as shown on plans. UNC inserts shall be stainless steel and be designed for a minimum of 15 foot-pounds of torque.

Ensure that prefabricated controller cabinet bases are designed to withstand wind loading of 125 mph (200 km/h) with the cabinets as shown in the Plans mounted. Ensure that prefabricated controller cabinet bases are designed for a minimum static vertical load of 5,000 pounds over a 10 inch (254 mm) by 10 inch (254 mm) by 1 inch (25 mm) thick distribution plate and withstand a tested load of 7,500 pounds. Ensure that prefabricated controller cabinet bases are designed for a minimum lateral load of 1800 pounds over an 18 inch (457 mm) by 24 inch (610 mm) by 1 inch (25 mm) steel plate applied to the longest side and shall withstand a tested load of 2700 pounds. The prefabricated controller cabinet base shall withstand a 50 foot-pound impact administered with a 12-pound weight having a “C” tup without puncture or splitting, in accordance with ASTM D2444. The prefabricated controller cabinet base shall meet the

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requirement of ASTM D543 Section 7, Procedure 1. Provide a copy of all test reports from a certified lab along with the materials certification package.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

General Provisions 101 through 150.

D. Materials Warranty

Refer to [Subsection 925.2.01.D](#) for Materials Warranties.

925.2.35 Loop Lead-In Cable

A. Requirements

Ensure that loop detector lead-in cable is No. 18 AWG, 3-pair shielded cable that meets IMSA specification #50-2.

Ensure that identification markings are stamped on the jacket.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

General Provisions 101 through 150.

D. Materials Warranty

Refer to [Subsection 925.2.01.D](#) for Materials Warranties.

925.2.36 Loop Detector Wire

A. Requirements

Ensure that loop detector wire, meets IMSA specification 51- -3 and is 14 AWG..

Ensure that identification markings are stamped on the cable jacket.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

General Provisions 101 through 150.

D. Materials Warranty

Refer to [Subsection 925.2.01.D](#) for Materials Warranties.

925.2.37 Aerial (Lashed) & Duct Signal Cable

A. Requirements

Ensure that aerial (lashed) or duct (conduit) No. 14 AWG, stranded, 7-conductor, with black polyethylene (PE) jacket and 600 V AC rating meets IMSA specification #20-1. Use conductors that are straight, not twisted pairs.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

General Provisions 101 through 150.

D. Materials Warranty

Refer to [Subsection 925.2.01.D](#) for Materials Warranties.

925.2.38 Self-Supporting Twisted Pair Aerial Signal Communications Cable

A. Requirements

Ensure that self-supporting, figure eight, aerial signal communications cable, No. 19 AWG, stranded 6-pair conductors is rated at 600 V AC and meet IMSA specification #20-4-1984.

Use conductors that are twisted pairs with copper tape shield under a black PE jacket. Ensure that messenger strand is 0.25 inch (6 mm), 7-strand and conforms to ASTM A 475 Siemens-Martin grade or better with a Class A coating.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

General Provisions 101 through 150.

D. Materials Warranty

Refer to [Subsection 925.2.01.D](#) for Materials Warranties.

925.2.39 Underground Feeder Cable, Type UF

A. Requirements

Ensure that underground feeder cable, Type UF w/ground has two (2) conductors with pvc/nylon jacket and a minimum 600 V AC rating per UL #493. Two-conductor, No. 6 AWG wire may be used.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

General Provisions 101 through 150.

D. Materials Warranty

Refer to [Subsection 925.2.01.D](#) for Materials Warranties.

925.2.40 Messenger & Guy Strand (Span Wire)

A. Requirements

Ensure that all messenger and guy strand (span wire) conforms to ASTM A 475 Extra High Strength grade or better with a Class A coating, 7-wire span wire.

Ensure ¼-inch (6 mm) Messenger & guy strand shall be used to support interconnect cable or as tether spans.

Messenger & guy strand 0.31 inch (7 mm) shall be used only where it is essential to match an existing 0.31 inch (7 mm) span wire that will not be replaced as part of a new installation.

Ensure all span wire for signal heads, blank out sign, optically programmed heads, lane control signs, standard, aerial or sidewalk guys uses a minimum Messenger & guy strand 0.38 inch (9 mm) as a minimum size.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

General Provisions 101 through 150.

D. Materials Warranty

Refer to [Subsection 925.2.01.D](#) for Materials Warranties.

925.2.41 Power Disconnect Box

A. Requirements

Ensure that all power disconnect boxes are NEMA 3R 240 V AC, 60 Amp Phase 1(metal non-fused 2 pole). Ensure the disconnect box is supplied with a padlock keyed as per directions of District Signal Engineer. Provide power disconnect box that is not fused and does not have a circuit breaker. Supply with a service grounding kit.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

General Provisions 101 through 150.

D. Materials Warranty

Refer to [Subsection 925.2.01.D](#) for Materials Warranties.

925.2.42 Cable Ties

A. Requirements

Ensure that all cable ties are nylon, ultraviolet resistant black and consist of the following as a minimum:

Nominal Length	8 inches (200 mm)
Width	0.30 inches (7 mm)
Tensile Strength	120 pounds (55 kg)

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

General Provisions 101 through 150.

D. Materials Warranty

Refer to [Subsection 925.2.01.D](#) for Materials Warranties.

925.2.43 Lashing Rod

A. Requirements

Ensure that all lashing rods are sized in accordance with messenger and cable(s) diameters to be supported. Provide lashing rods that are of the same material as the messenger or guy strand.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

General Provisions 101 through 150.

D. Materials Warranty

Refer to [Subsection 925.2.01.D](#) for Materials Warranties.

925.2.44 Stainless Steel Lashing Wire

A. Requirements

Provide lashing wire that is type 316 stainless steel with 0.045 inch (1 mm) diameter.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

General Provisions 101 through 150.

D. Materials Warranty

Refer to [Subsection 925.2.01.D](#) for Materials Warranties.

925.2.45 Guy Guards

A. Requirements

Ensure that all guy guards are high impact resistant PVC with ultraviolet stabilizers added for retention of color. Ensure that insulators attach to the guy so that they cannot easily be removed. Use guy insulators which are yellow unless otherwise directed.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

General Provisions 101 through 150.

D. Materials Warranty

Refer to [Subsection 925.2.01.D](#) for Materials Warranties.

925.2.46 Guy Strain Insulators

A. Requirements

Ensure guy strain insulators are protected from the environment including the effects of voltage, ultraviolet rays, and acid rain by a fully bonded, electrically tack-free, and impenetrable silicone rubber sheath. Each insulator shall be UL proof tested, and permanently marked to show date of test.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

General Provisions 101 through 150.

D. Materials Warranty

Refer to [Subsection 925.2.01.D](#) for Materials Warranties.

925.2.47 Universal Closure Kit

A. Requirements

Supply a Universal Signal Closure Kit to seal the signal head at either the top or bottom. Ensure that the kit will fit any manufacturer's signal head (top or bottom) without the use of special tools or modification.

1. Ensure that the gasket is 60-70 durometer neoprene.
2. Ensure that Closure Cap is injection molded ABS plastic. The plastic is to be loaded with UV stabilizers.
3. Ensure that Adapter Bar is made so that it will secure the closure cap and compensate for varying thickness of signal heads.
4. Provide two # 10 (9mm) screws to fit any manufacturer's signal head. Ensure that one screw is 0.75 inches (19 mm) in length and the second screw is 1 inch (25 mm) in length.
5. Pack each assembly in a clear plastic bag. Mark the bag with the manufacturer's name and part number. Include the Universal Signal Closure Kit in a package containing the span wire clamp and Tri-Stud wire entrance fitting.
6. Ensure that the Closure Cap is molded to closely match the color of the signal head (Federal Yellow). The adapter bar and screws are to be zinc plated steel.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

General Provisions 101 through 150.

D. Materials Warranty

Refer to [Subsection 925.2.01.D](#) for Materials Warranties.

925.2.48 Cast Aluminum Span Wire Clamp

A. Requirements

Provide Span Wire Clamps that are cast from Aluminum Alloy 713 or equivalent, free of voids, pits, dents, molding sand and excessive foundry grinding marks. Ensure that all design radii are smooth and intact.

Provide an exterior surface finish that is smooth and cosmetically acceptable, free of molding fins, cracks and other exterior blemishes. Ensure that span wire clamps are fabricated from aluminum ingot with minimum requirements as follows:

- ALUMINUM ALLOY No. 713
- YIELD STRENGTH, ksi (MPa) 25 (172)
- TENSILE STRENGTH, ksi (MPa) 35 (240)
- BRINELL HARDNESS 75
- ELONGATING [% in 2 inches (50 mm)] 3

1. Ensure that the Span Wire Clamp can accommodate cables 0.25 inch (6 mm) to 0.63 inch (16 mm) diameter.
2. Ensure that the weight is less than 1.75 pounds (0.8 kg) with hardware.
3. Ensure that the Span Wire Clamp have a minimum overall length of 7 inches (175 mm).
4. Ensure that the Span Wire Clamp have a centerline dimension from cable to clevis pin of 2 inches (50 mm) [+/- 0.5 inches (13 mm)].
5. Ensure that the Span Wire Clamp have a cast aluminum cable bar to protect the cable when tightening the U-bolts.
6. Ensure that the Span Wire Clamp have a mounting opening of 0.75 inches (19 mm) [+/- 0.03 inches (0.8 mm)].
7. Ensure that the Span Wire Clamp have 0.5 inch (13 mm) - 13 NPT U-bolts with 0.5 inch (13 mm) lock washers and nuts.
8. Ensure that the clevis pin are 0.63 inch (16 mm) diameter with a length of 2.25 inches (56 mm) and secured with a hump back stainless steel cotter pin.
9. Ensure that the Clamp and Cable Bar have an Alodine 1200 conversion coating to help resists oxidation.
10. Ensure that the Clevis Pin and hardware are galvanized per ASTM 123/A 123M or stainless steel.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

General Provisions 101 through 150.

D. Materials Warranty

Refer to [Subsection 925.2.01.D](#) for Materials Warranties.

925.2.49 Cast Aluminum Tri-Stud Span Wire Entrance Fitting

A. Requirements

Ensure that the Tri-Stud Span Wire Entrance Fittings are cast from Aluminum Alloy 713 or equivalent, free of voids, pits, dents, molding sand and excessive foundry grinding marks.

Ensure that the all design radii are smooth and intact. Ensure that the exterior surface finish is smooth and cosmetically acceptable, free of molding fin, cracks and other exterior blemishes.

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Ensure that the material is fabricated from aluminum ingot with minimum requirements as follows:

- ALUMINUM ALLOY No. 713
- YIELD STRENGTH, ksi (MPa) 25 (172)
- TENSILE STRENGTH, ksi (MPa) 35 (240)
- BRINELL HARDNESS 75
- ELONGATION [% in 2 inches (50 mm)] 3

1. Ensure that the Tri-Stud Span Wire Entrance fitting has a mounting support at the top of the wire entrance 0.69 inches (17 mm) thick [+/- 0.07 inches (1.5 mm)].
2. Ensure that the Tri-Stud Span Wire Entrance fitting weight is not less than 1.75 pounds (0.8 kg) with hardware.
3. Ensure that the mounting support has at least six (6) clevis openings for adjustment with suspension bracing between every two (2) openings.
4. Ensure that the Tri-Stud Span Wire Entrance has a minimum of 0.5 inch (13 mm) diameter throughout for wire access and that wire access is free of burrs and casting webs.
5. Ensure that the Wire Entrance opening is recessed and has a neoprene grommet with sealed membrane sections.
6. Ensure that the signal head attachment end is serrated and has a minimum of 3-signal head centering bosses extending 0.19 inches (5 mm) from the serrations.
7. Ensure that the serrations have a 72-tooth design to match the signal head.
8. Ensure that three (3) stainless steel studs are cast into the wire entrance fitting. Ensure that the studs are 0.31 inches (7 mm) and extend 1.5 inches (38 mm) [+/- 0.13 inches (4 mm)] beyond the serrations. Provide each Tri-Stud span wire entrance fitting with a Tri-Stud hardware kit.
9. Ensure that the Tri-Stud Span Wire Entrance Fitting has an alodine conversion coating to provide a proper base for paint adhesion. Ensure that the assembly is painted federal yellow and baked in a drying oven after painting.
10. Ensure that the all Hardware is galvanized or stainless steel.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

General Provisions 101 through 150.

D. Materials Warranty

Refer to [Subsection 925.2.01.D](#) for Materials Warranties.

925.2.50 Bull Rings

A. Requirements

Provide bull rings that are galvanized weldless steel 0.63 inch (16 mm) diameter. Submit catalog cuts for approval.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

General Provisions 101 through 150.

D. Materials Warranty

Refer to [Subsection 925.2.01.D](#) for Materials Warranties.

925.2.51 Ramp Meter Enforcement Device

A. Requirements

For each metered lane, provide one ramp meter enforcement device mounted on the back of one signal per lane and wired directly to the red signal display, (Refer to 647.3.05.L). This installation shall include a Red 44 LED Array

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(allnGaP), Pixel housing, 6061 aluminum powder coated swivel bracket, 2 inch lens, with an aluminum hood. Mounted and adjusted as per the Plans.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

General Provisions 101 through 150.

D. Materials Warranty

Refer to [Subsection 925.2.01.D](#) for Materials Warranties.

925.2.52 Advance Warning Flasher Blank-Out Sign

A. Requirements

The Advance Warning Flasher blank-out sign shall display the message “PREPARE TO STOP” and shall have the dimensions shown in the Plans. The advance warning flasher blank-out sign assembly shall consist of:

- The legend color shall be double stroke red LED Letters
- The LED shall conform to the Federal color Standards.
- The formed letters shall conform to the United States Department of Transportation's Standard Alphabet.
- Two yellow 12 inches (300 mm) traffic signal heads (flashing Beacons) shall be mounted on each end of the sign as shown in the Plans.
- The Yellow Flashing Beacon will be designed using the 925.2.06 Flashing Beacon Assembly, 925.2.15 LED Signal Modules, and 925.2.11 Vehicle Signal Heads requirements. The Yellow Flashing Beacon shall alternate. The flashing beacon cabinet assembly shall be located outside attached to the sign pedestal pole. The surge arrester in the flashing beacon cabinet assembly shall protect the blank-out sign and the flasher unit/flashing beacons. Provide a non-fused disconnect switch instead of the circuit breaker required in 925.2.06, wired to disconnect all power to the advance warning flasher assembly.
- The sign shall be equipped with a photo-cell for dimming of the sign legend. Dimming shall be as per the manufacturers Specifications.
- The assembly shall be capable of continuous operation over a temperature range of -37 °C (-34 F) to +74 °C (165 F). The advance warning flasher blank-out sign assembly housing shall consist of:
 - The entire front face of the sign shall be protected by a sheet of polycarbonate mounted in the cast door frame. Lens material shall be 3 millimeter thick clear polycarbonate with vandal resistant properties.
 - The sign shall include a 2.5 millimeter thick aluminum weatherproof housing and door with internal structural frame.
 - The interior of the unit shall be painted with a flat black enamel to eliminate internal reflection and two coats of yellow standard color No. 13538 baking enamel for exterior surfaces.
 - The signal shall completely blank-out when not energized.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

General Provisions 101 through 150.

D. Materials Warranty

Refer to [Subsection 925.2.01.D](#) for Materials Warranties.

925.2.53 Vinyl Electrical Tape

A. Requirements

Ensure electrical tape used is flame retardant, cold and weather resistant. Provide tape that is rated for 600 volts and for use between 0 F (-18 C) and 176 F (80 C).

Section 925—Traffic Signal Equipment

Ensure tape is 0.0085 inches (0.2 mm) thick and meets the requirements of UL 510 and Mil-I-24391. Provide tape that remains flexible with abrasion resistance.

B. Fabrication

General Provisions 101 through 150.

C. Acceptance

General Provisions 101 through 150.

D. Materials Warranty

Refer to [Subsection 925.2.01.D](#) for Materials Warranties.

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA**

SPECIAL PROVISION

**Section 934—Rapid Setting Patching Materials for Portland Cement
Concrete**

Delete Section 934 and substitute the following:

934.1 General Description

This section includes the requirements for rapid setting patching materials used in Portland cement concrete.

934.1.01 Related References

A. Standard Specifications

[Section 886—Epoxy Resin Adhesives](#)

B. Referenced Documents

AASHTO	ASTM
T 97	C 31/C31M
T 260	C 109/C 109M
	C 140
	C 666

Federal Hazardous Products Labeling Act

[QPL 27](#)

934.2 Materials

934.2.01 Rapid Setting Patching Materials

A. General Requirements

1. Use rapid setting patching materials that have the following characteristics:
 - Are nonmetallic.
 - Have a color similar to Portland cement concrete.
 - Can be mixed and placed like concrete.
 - Have accelerated hardening characteristics.
 - Yield a permanent patch in concrete that can withstand traffic within 2 hours.

For a list of sources, see [QPL-27](#).

2. Type I
Use Type I to patch reinforced or nonreinforced horizontal Portland cement concrete surfaces.
3. Type II
Use Type II to patch only nonreinforced horizontal Portland cement concrete surfaces.
4. Type III
Use Type III to patch reinforced vertical or overhead Portland cement concrete surfaces.

5. Classify Type I, Type II, and Type III as follows:
 - a. Class A, Premixed: Use these materials as received by adding water or an activator solution, according to the manufacturer's instructions.

NOTE: DO NOT add extra aggregate to Class A patching material without approval from the Office of Materials and Research.

- b. Class B, Non-Premixed: These materials contain no aggregate. Add aggregate (fine and/or coarse) according to the manufacturer's recommendations.
6. Type IV
Use elastomeric patching material to patch nonreinforced horizontal Portland cement concrete surfaces.
7. Type V
Use two-component cross linked resins to patch nonreinforced horizontal Portland cement concrete surfaces.
8. Type VI
Use cementitious, rapid setting, structural repair mortar to patch nonreinforced horizontal Portland cement concrete surfaces.

B. Physical Requirements

1. Use Type I, Type II, and Type III patching materials that have been evaluated by the National Transportation Product Evaluation Program (NTPEP) or other approved test facility, and meet the following requirements.

Requirement	Measurement
Flow of Mortar, Type I and Type II Type III	100% minimum 80% to 100%
Flexural Strength, Minimum	500 psi (3.5 MPa) in 24 hours
Compression Strength, Minimum	
2 hours	1,200 psi (8.5 MPa)
24 hours	3,000 psi (20 MPa)
7 days (moisture cure)	4,000 psi (27.5 MPa)
Absorption, Maximum	10%
Shear Bond, Minimum	200 psi (1.5 MPa) in 24 hours
Freeze Thaw Durability Factor	75% of the reference concrete after 300 freeze-thaw cycles
Total Chlorides	
Type I and Type III	0.6 lb/yd ³ (0.4 kg/m ³) maximum
Type II	No limits

C. Fabrication

1. Packaging
 - a. Package this material in strong, moisture-proof paper bags or other suitable containers that can withstand shipping, normal handling, and storage without breaking.
 - b. Clearly label each container of the components of a patching system with the following information:
 - Component designation, if two components.
 - Manufacturer's batch number.

- Mixing ratio and directions.
- Potential hazards and precautions displayed according to the Federal Hazardous Products Labeling Act.

D. Acceptance

1. Follow the mixing instructions of the manufacturer to create test specimens.
2. Air-cure all test specimens except for the 7-day moisture cure cubes.
3. Test Types I, II, and III using the following methods:

Test	Method
Flow of mortar	ASTM C 230
Flexural strength	AASHTO T 97
Compressive strength	ASTM C 109/C 109M or C 31/C 31M, whichever is applicable
Absorption	ASTM C 140
Shear bond strength	See Subsection 934.2.01.C , "Acceptance", Step 4
Rapid freeze thaw	ASTM C 666
Total chlorides	AASHTO T 260

4. Shear Bond Strength
 - a. Place a Type II epoxy resin adhesive meeting the requirements of [Section 886](#) on the surface of a cured mortar bar 16 x 3 x 3 in (400 x 75 x 75 mm).
 - b. Cast a 16 x 2 x 0.5 in (400 x 50 x 13 mm) rapid-setting material patch in the center of the mortar base.
 - c. Air-cure the test sample for 24 hours.
 - d. Saw the mortar bar base and the cured rapid setting material patch into 2 in (50 mm) segments for testing.
 - e. Use a holding device and plunger to apply a load at a rate of 0.05 in (1.3 mm) per minute to the patch until the patch fails.
 - f. Read the load in pounds (newtons) on the plunger.
 - g. Calculate the shear bond strength in pounds per square inch by dividing the load in pounds by the interfacial area of the patch in square inches. Calculate the metric equivalent for shear bond strength in MPa by dividing the load in newtons by gravitational acceleration (9.81 m/s²).
5. Use Type IV, Type V and Type VI patching materials that have been evaluated by NTPEP, and received a subjective field rating of ≥ 4 on an ascending scale from 1 to 5.
6. The Department will reject a patching system that meets all the requirements of this Specification, but does not work as required in actual use.

E. Materials Warranty

Ensure that the material has a minimum storage life of at least 1 year under conditions of 40° to 90° F (4° to 32° C) and maximum relative humidity of 90 percent.

Office of Materials & Research

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA**

SPECIAL PROVISION

Construction Activity Schedule

To satisfy the requirements of the NPDES Permit for storm water discharge, the successful bidder submit a Construction Activity Schedule that provides the timing of all major construction activities no later than ten calendar days following award of the Contract by the Department. Include in the schedule, the estimated project start date and the Completion Date specified in the Contract.

Send the Construction Activity Schedule to the Office of Construction Bidding Administration. The Construction Activity Schedule may be submitted with the executed contract.

Failure or refusal to submit the Construction Activity Schedule

Failure or refusal to submit the Construction Activity Schedule shall be deemed either:

1. Failure to execute the Contract, if the Contract has not yet been executed; or
2. Material breach of the Contract, if the Contract has been executed.

If the Contractor fails to execute the Contract as stated in Item 1, above, the bid bond shall become the property of the Department, not as a penalty, but in liquidated damages sustained. If the Contractor fails to submit the Construction Activity Schedule after execution of the Contract, the Contractor will be declared in default of the Contract.

The submittal of the Construction Activity Schedule is in addition to the Progress Schedule required by the Contract according to Section 108.03—PROSECUTION AND PROGRESS of the Specifications.

Date: May 29, 2001
First Use Date 2001 Specifications: November 1, 2002
Revised: July 28, 2009

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA**

SPECIAL PROVISION

**Section 103—Award and Execution of Contract
(50 Day Clause)**

Delete paragraph one of Subsection 103.02 and substitute the following:

If a Contract is Awarded, it will be Awarded to the lowest reliable bidder whose Proposal shall have met all the prescribed requirements. The Contract will be Awarded, if at all, within 50 calendar days after the opening of the Proposals, unless a longer period is specified in the Proposal or the successful Bidder agrees in writing a longer period for the Award.

**Georgia Department of Transportation
State of Georgia
Special Provision**

P.I. No.: 0010290 & 0010311
Fulton County
Forsyth County

Section 105 - Control of Work

Delete Section 105.04 and Substitute the following:

105.04 Coordination of Plans, Specifications, Supplemental Specifications, and Special Provisions

The *Standard Specifications*, the Supplemental Specifications, the Plans, Special Provisions, and all supplementary documents 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 cases of discrepancy, the governing descending order will be as follows:

1. Special Provision Section 999- Design - Build
2. Special Provisions
3. Project Plans including Special Plan Details
4. Supplemental Specifications
5. Standard Plans including Standard Construction Details
6. Standard Specifications

Calculated dimensions will govern over scaled dimensions.

The Contractor shall take no advantage of any apparent error or omission in the Plans or Specifications. In the event the Contractor discovers such an error or omission, he shall immediately notify the Engineer. The Engineer will then make such corrections and interpretations as may be deemed necessary for fulfilling the intent of the Plans and Specifications.

A. Specifications of Other Organizations

When work is specified to be done or when materials are to be furnished according to the published specifications of organizations other than the Department, the latest specifications published by those organizations at the time bids are received shall apply unless otherwise specified.

AASHTO Interim Specifications and ASTM Tentative Specifications will be considered effective on date of issue.

B. Item Numbers

The first three digits of any Item Number in the itemized Proposal designates the Specification section under which the Item shall be constructed.

Office of Construction Bidding Administration

February 10, 2012
(Design-Build)

DEPARTMENT OF TRANSPORTATION

STATE OF GEORGIA

SPECIAL PROVISION

P.I. No.: 0010290 & 0010311

Fulton County

Forsyth County

SECTION 105 – CONTROL OF WORK

Delete Sub-Section 105.07 and substitute the following:

105.07 COOPERATION BETWEEN CONTRACTORS

The Department reserves the right at any time to Contract for and perform other or additional work on or near the Work covered by the Contract. It is anticipated that future contracts will be let, including but not limited to the SR 400 @ CR 458/McFarland Pkwy ramp meters and SR 400 @ CR 458/McFarland Pkwy to SR 20 ITS Installation (P.I. Nos.: 0009956 and 0010291) during the life of this Contract.

When separate Contracts are let within the limits of any one Project, each contractor shall conduct his work so as not to interfere with or hinder the progress or completion of The Work being performed by other Contractors. Contractors working on the same Project shall cooperate with each other.

Each Contractor involved shall assume all liability, financial or otherwise, in connection with his 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 by him because of the presence and operations of other Contractors working within the limits of the same Project.

The Contractor shall arrange his work and shall place and dispose of the materials being used so as not to interfere with the operations of the other contractors within the limits of the same Project. He shall join his work with that of the others in an acceptable manner and shall perform it in proper sequence to that of the others.

DEPARTMENT OF TRANSPORTATION

STATE OF GEORGIA

SPECIAL PROVISION

PROJECT NUMBER

COUNTY FULTON & FORSYTH

P.I. No.: 0010290 & 0010311

SECTION 108 - PROSECUTION AND PROGRESS

Retain Sub-Section 108.08 as written and add the following:

108.08. C: Intermediate Completion

An overall Completion Date is established for this Project.

For this project the following item of work and corresponding intermediate time is required:

SR 400

1. Failure to re-open travel lanes as specified in Special Provision Section 150.11.A.1 will result in the assessment of liquidated damages in the amount of \$5,000.00, per hour or portion thereof.
2. Failure to adhere to the Thanksgiving through Christmas holiday restriction in Section 150.11.A.2 will result in the assessment of Liquidated Damages in the amount of \$5,000 per day or portion thereof.
3. ITS System
Failure to adhere to outage restrictions as specified in Section 150.11.C will result in the assessment of Liquidated Damages at a rate of \$2000.00 per hour or any part thereof.

The above rates are cumulative and are in addition to any Liquidated Damages which may be assessed for failure to complete the overall project.

Office of Innovative Program Delivery

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA**

SPECIAL PROVISION

**P.I. No.: 0010290 & 0010311
Fulton County
Forsyth County**

Section 150 – Traffic Control

Add the following to Section 150:

150.11 Special Conditions

A. WORK HOURS:

1. The Contractor shall not install lane closures, perform flagging, or move equipment on the travel way between the hours of 6:00 a.m. to 9:00 a.m. and 3:00 p.m. to 8:00 p.m. Monday thru Thursday, 6:00 a.m. to 9:00 p.m. Friday, and between the hours of 8:00 a.m. to 7:00 p.m. Saturday and Sunday.
2. The Contractor shall not install lane closures, perform flagging, or move equipment on the travel way from the Wednesday before Thanksgiving Day to the first Business day after New Year's Eve.
3. Double lane closures are not allowed at any time.

Failure in maintaining work hours within the time specified will result in the assessment of Liquidated Damages as specified in Special Provision 108.08.C.

B. WORKZONE LAW ENFORCEMENT:

Workzone law enforcement consists of utilizing uniformed police officer(s) equipped with a marked patrol vehicle and blue flashing lights to enforce traffic laws in construction workzones and the administration of this service. Payment for Workzone law enforcement shall be made only for its utilization in workzones during lane closures, traffic pacing, or other activities that occur within travel lanes. The Contractor shall be responsible for coordinating and scheduling the utilization of the Workzone Law Enforcement.

Workzone Law Enforcement will be measured and paid for by the hour up to maximum number of hours included in the Contract. The Department will not pay for any Workzone Law Enforcement beyond the number of hours included in the Contract. The cost for utilization above the number of hours included in the Contract shall be included Lump Sum price bid for Construction Complete.

The Contractor shall provide a daily work record containing the actual number of hours charged by the police officer, to be paid by the Department. The daily work record shall be compiled on form provided by the Department, signed by the police officer and the Contractor's Worksite Traffic Control Supervisor attesting that the police office was utilized during the hours recorded.

Payment shall be full compensation for reimbursing the law enforcement agency, and for all other cost incurred by the Contractor in coordinating, scheduling, and administering the item Workzone Law Enforcement.

Payment shall be made under:

ITEM NO. 150-9011 - Traffic Control Workzone Law Enforcement (Contractor Bids) per HR.

C. ITS System:

The ITS System on SR 400 and all those portions outside of the Project limits needed for temporary and permanent signing shall not be taken out of service for more than 24 hours at any time during construction.

Within 24 hours, the Contractor shall repair any broken fiber/cable of the ITS System on SR 400 within Project limits that is damaged by the Contractor at no cost to the Department. Repairs and/or replacement should be consistent with Special Provisions 935, 936, 937, and 939. Construction activities resulting in a failure to restore system functionality within the time specified will result in the assessment of Liquidated Damages as specified in Special Provision 108.08.C.3.

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA**

SPECIAL PROVISION

P.I. No.: 0010290 & 0010311

Fulton County

Forsyth County

Section 935 - Fiber Optic System

Delete Section 935 and substitute the following:

Section 935 – Fiber Optic System

935.1 General Description

This work includes the installation of fiber optic cable and equipment including but not limited to cable, interconnect, patch cords, FDC interconnect cables/pig tails, any cable related hardware, connectors, splices, closures, temporary systems, testing, training, or any other fiber optic product as specified on the Plans, or noted in any other Section of these Specifications.

Provide all equipment and materials of like kind and function to be of the exact same manufacture, model, revision, firmware, etc.

Provide all equipment, materials, and work in accordance with all manufacturers' recommendations.

935.1.01 Definitions

Not applicable

935.1.02 Related References

A. Georgia Standard Specifications

Section 150 – Traffic Control

Section 639 – Strain Poles for Overhead Sign and Signal Assemblies

Section 647– Traffic Signal Installation

Section 682 – Electrical Wire, Cable, and Conduit

B. Referenced Documents

Optical Fiber Standards

Office of Traffic Operations

Apply binders with sufficient tension to secure the buffer tubes to the central member without crushing the buffer tubes. Use only binders that are non-hygroscopic, non-wicking (or rendered so by the flooding compound), and dielectric with low shrinkage.

- c. Cable Core: Protect the cable core with a water blocking material. The water blocking material shall be non-nutritive to fungus, electrically non-conductive and homogenous.
- d. Strength Members: Use a central anti-buckling member consisting of a glass reinforced plastic rod to prevent buckling of the cable.

Use high tensile strength aramid, fiberglass, or a combination of aramid and fiberglass yarns to provide tensile strength. Fillers or rods may be included in the cable core to lend symmetry to the cable cross-section where needed.

- e. Color : Distinguish each fiber and buffer from others by means of color coding according to the following:

- | | | |
|-----------|----------|------------|
| 1. Blue | 5. Slate | 9. Yellow |
| 2. Orange | 6. White | 10. Violet |
| 3. Green | 7. Red | 11. Rose |
| 4. Brown | 8. Black | 12. Aqua |

Ensure these colors meet EIA/TIA-598-B, "Color Coding of Fiber Optic Cable."

For cables containing more than 12 buffer tubes, use the color code shown above for tubes 1 through 12, and use stripes or tracers in conjunction with the standard color code for tubes 13 through 24.

The colors shall be stable during temperature cycling and not subject to fading or smearing onto each other or into the gel filling material. Ensure colors do not cause fibers to stick together.

- f. Cable Jacket: Include in the cable at least one ripcord under the sheath for easy sheath removal.

Helically strand the high tensile strength yarns evenly around the cable core.

Sheath all dielectric cables with medium density polyethylene. The minimum nominal jacket thickness shall be 0.06 in (1.5 mm). Apply jacketing material directly over the tensile strength members and water-blocking compound. The polyethylene shall contain carbon black to provide ultraviolet light protection and cannot promote the growth of fungus.

Ensure that the jacket or sheath to be free of holes, splits, and blisters.

Ensure that the cable jacket contains no metal elements and is of a consistent thickness.

- g. Marking: Mark cable jackets using the following template, unless otherwise shown in the Plans:

Manufacturer's Name - Optical Cable - Year - Telephone Handset Symbol – GA DOT - Description

Where the Description conforms to the following depending on cable type:

- Multimode Cable: XXF MM
- Single-Mode Cable: XXF SM
- Hybrid Cable: XXF SM / XXF MM

XX denotes the fiber count

Mark the cable length every meter, every 2 ft if marking the cable in English units. Ensure the actual length of the cable to be within -0/+1% of the length markings.

Use cable marking that is contrasting in color to the cable jacket. The height of the marking shall be approximately 0.10 in (2.5 mm).

2. Additional Requirements for Loose Tube Cable

Use only cable that is all dielectric, loose tube design. Ensure buffer tubes are stranded around a central member using the reverse oscillation, or "SZ", stranding process.

3. Cable Performance

All OSP cable shall meet or exceed the requirements of the Fiber Optic Test Procedure (FOTP) criteria referenced in 7 CFR 1755.900. Upon the request of the Department, provide certification from an independent testing laboratory that certifies that the cable conforms to the specifications and test procedures.

- a. Pulling Tension: Ensure that the cable can withstand a maximum pulling tension of 600 lbf (2.7 kN) during installation (short term) and 200 lbf (890 N) long term installed.
- b. Temperature Range: Provide only OSP cable with shipping, storage, and operating temperature range of -40 °F to +160 °F (-40 °C to +71 °C). The installation temperature range of the cable shall be -20 °F to +160 °F (-30 °C to +71 °C).

C. Inside Plant (IP) Cable

This section sets forth the general standards for fabrication and design of inside plant fiber optic cable.

1. IP Cable Construction

a. Strength Members: For the strength member, use a high modulus U.S. manufactured aramid yarn. The aramid yarns shall be helically stranded around the buffered fibers. Ensure that non-toxic, non-irritant talc is applied to the yarn to allow the yarns to be easily separated from the fibers and the jacket. For all IP cables used in plenum structures, use only IP cable that meets NEC UL-910 requirements for plenum rated cables.

b. Cable Jacket: Ensure the jacket to be continuous, free from pinholes, splits, blisters, or other imperfections. The jacket shall be smooth, as is consistent with the best commercial practice. The jacket should provide the cable with a tough, flexible, protective coating, able to withstand the stresses expected in installation and service.

Use orange cable jackets for multi-mode and yellow cable jackets for single mode.

Design the cable jacket for easy removal without damage to the optical fibers by incorporating a ripcord under each cable jacket. Ensure that a non-toxic, non-irritant talc is applied to the aramid/fiberglass yarns to allow the yarns to be easily separated from the fibers and the jacket.

Ensure that the nominal thickness of the cable outer jacket is sufficient to provide adequate cable protection while meeting the mechanical, flammability, and environmental test requirements of this document over the life of the cable.

c. Color: Use color coded individual fibers for identification. The color coding shall be in accordance with EIA/TIA-598-B "Optical Fiber Cable Color Coding" as stated in 935.2.B.1.e. Use coloring material that is stable over the temperature range of the cable, is not susceptible to migration, and does not affect the transmission characteristics of the optical fibers. Use color coded buffered fibers that will not adhere to one another. When grouping fibers into individual units, number each unit on the sub-unit jacket for identification. Repeat the number approximately every 6.0 in (150 mm).

d. Marking: Mark the outer cable jacket at least every 3 ft (1 m) with the manufacturer's name or UL file number, date of manufacture, fiber type, flame rating, UL symbol, and sequential length marking (e.g. "62.5/125 MICRON Type OFNR - UL"). Use print color that contrasts to the color of the jacket and is permanent and legible for the life of the cable.

2. Construction by Cable Type

a. Interconnect Cables: Use interconnect cable to connect the distribution panels of a fiber optic cable plant with the actual electronic devices. The cross connect system requires either one or two fiber cable or cordage dependent upon the electronic connector requirement. Construct interconnect cable by surrounding the 900 μm tight buffered fibers with layered U.S. manufactured aramid yarns and a jacket of PVC or Copolymer depending on NEC requirements. Use the aramid yarns as tensile strength members. The cordage shall be allowed in one fiber simplex, two fiber duplex (round) or two fiber ZIP cordage.

b. FDC Interconnect Cable: Use this cable to splice a factory connectorized multifiber pigtail cable on to an OSP cable end, routing that cable within an FDC and its splice cabinet, and connecting to the termination panels of the FDC. Construct FDC interconnect cable of 900 μm tight buffered fiber (single mode or multi-mode optical fiber) surrounded with U.S. manufactured aramid fibers, and jacketed with flame retardant jacket material. Ensure that the optical fiber is proof tested to 100 kpsi (690 MPa) and that it meets all the optical fiber requirements of this Specification. Ensure that the factory-installed connectorization meets all requirements of this Specification. Match the fiber count and buffer tube configuration of the FDC interconnect cable to be exactly equivalent to the OSP cable being terminated in the FDC, unless additional fibers (using other buffer tube colors) are required for an FDC that is larger than the OP cable. Use an orange exterior jacket for the FDC interconnect cable for multi-mode and a yellow exterior jacket for single-mode. Label FDC interconnect cables exactly as for the OP cable when the FDC interconnect cable must be routed to the exterior of the FDC and its splice cabinet.

c. For cables with less than 8 fibers: Use fibers that are stranded around a U.S. manufactured aramid yarn central member and surrounded by layered U.S. manufactured aramid yarns. Use aramid yarns to serve as the tensile strength member of the cable. Apply a ripcord between the aramid yarns and the outer jacket to facilitate jacket removal. The outer jacket shall be extruded over the aramid yarns for physical and environmental protection.

d. For cables with 8 up to 24 fibers: Use cables that have individual fibers stranded around a glass reinforced plastic (GRP) central member and surrounded by layered U.S. manufactured aramid yarns. The GRP central member provides anti-buckling to ensure consistent attenuation performance across the operating temperature range of the cable. Apply a ripcord between the aramid yarns and the outer jacket to facilitate jacket removal. The outer jacket shall be extruded over the aramid yarns for physical and environmental protection

e. For cables with 24 to 72 fibers: Group together the buffered fibers in six-fiber sub-units. In each sub-unit, strand the individual fibers around a U.S. manufactured aramid yarn central member and surround the sub-unit by layered aramid yarns. Incorporate a ripcord in the sub-unit design to facilitate access to the individual fibers. The sub-unit jacket shall be extruded over the aramid yarns for additional physical and environmental protection. Strand the sub-units around a GRP central member. The GRP central member provides anti-buckling to assure consistent attenuation performance across the operating temperature range of the cable. Insert a ripcord beneath the outer jacket to facilitate jacket removal. The outer jacket shall be extruded around the units for physical and environmental protection.

f. For cables with more than 72 fibers: Group together the buffered fibers in twelve fiber sub-units. In each sub-unit, strand the individual fibers around a dielectric central member and surround the sub-unit by layered aramid yarns. Incorporate a ripcord in the sub-unit design to facilitate access to the individual fibers. The sub-unit jacket shall be extruded over the aramid yarns for additional physical and environmental protection. The sub-units may be stranded around a dielectric central member. Insert a ripcord beneath the outer jacket to facilitate jacket removal. The outer jacket shall be extruded around the units for physical and environmental protection.

3. Temperature Range

Ensure that the storage temperature range for the cable on the original shipping reel to be -40°F to $+160^{\circ}\text{F}$ (-40°C to $+71^{\circ}\text{C}$). The operating temperature range for riser cables shall be 0°F to $+160^{\circ}\text{F}$ (-18°C to $+71^{\circ}\text{C}$). The operating temperature range for plenum cables shall be 32°F to $+160^{\circ}\text{F}$ (0°C to 71°C).

4. Crush Resistance Requirements

Ensure that the cable can withstand a minimum compressive load of 0.061 plf (0.89 N/m) applied uniformly over the length of the compressive plate. Use only cable that has been tested in accordance with FOTP-41, "Compressive Loading Resistance of Fiber Optic Cables." While under the compressive load, the fibers shall not experience an attenuation change of greater than 0.4 dB at 1550 nm for single-mode or greater than 0.6 dB at 1300 nm for multimode. After the compressive load is removed, the fibers shall not experience an attenuation change greater than 0.2 dB at 1550 nm for single-mode or greater than 0.4 dB at 1300 nm for multimode.

5. Impact Resistance Requirements

Use only cable that can withstand a minimum of 20 impact cycles. Use only cable that has been tested in accordance with FOTP-25, "Repeated Impact Testing of Fiber Optic Cables and Cable Assemblies." The fibers shall not experience an attenuation change greater than 0.2 dB at 1550 nm for single-mode or greater than 0.4 dB at 1300 nm for multimode.

6. Flammability

Use only cables that are UL-listed in accordance with NEC, Article 770. Riser cables (OFNR) shall pass UL-1666. Plenum cables (OFNP) shall pass UL-910.

D. Patch Cords and FDC Interconnect Cables/ Pig Tails

1. Patch Cords

Use patch cords consisting of a length of fiber optic cable terminated on both ends. For all IP cables used in plenum structures, use only IP cable that meets NEC UL-910 requirements for plenum rated cables.

a. Construction: Ensure that all factory preconnectorized assemblies adhere to the applicable cable, cordage, and fiber specifications stated in these Specifications.

All inside plant (IP) patch cords shall meet NEC jacketing requirements.

Use orange outer jackets for multimode and yellow jackets for single mode.

Use connector boots of two (2) colors for all duplex patch cords, zip cord or round. Use white or off white for one leg of the duplex cord (non-printed zip leg) and red for the opposite leg (printed zip leg) of the duplex cord.

For all assemblies for outside plant (OSP) where loose tube is used, include a fan-out kit installed at each connectorized end.

Ensure that all connectors conform to Subsection 935.3.04.A.

No splices of any type are allowed within a patch cord assembly.

b. Testing: Fully test each assembly and place those test results on a test tag for each mated pair of connectors. Attach the tag to one end of each pair within the assembly.

Individually package each assembly within a plastic bag and clearly mark on the outside of that bag the submitted manufacturer's part number.

2. Factory Connectorized FDC Interconnect Cables/Pig Tails

Use FDC interconnect cables/pig tails that consist of a length of fiber optic cable of one single fiber terminated on one end. Use only FDC interconnect cables/pig tails with factory installed connectors in accordance with Subsection 935.2.F. Provide FDC interconnect cables/pig tails with 900 micron tubing or 3 mm fan out tubing as required for the application. Use FDC interconnect cables/pig tails with 900 micron tubing only when fully enclosed within an FDC. Ensure that the other end of the cable is properly prepared for splicing to another cable. The FDC interconnect cable/pig tail shall conform to the same construction and testing requirements as patch cords.

E. Drop Cable Assembly – Outside Plant

Drop cable assembly is defined as a connectorized fiber optic cable (drop cable) and appropriate fan out (if required) used for connectivity between a primary fiber trunk or feeder cable and field devices such as signal controllers, closed circuit television cameras, video detection system cameras, changeable message signs, etc.

1. General Requirements

Provide a loose tube design drop cable in the drop cable assembly meeting the requirements for outside plant cable as specified in Subsection 935.2.B. Provide the drop cable assembly type (multimode, single-mode or hybrid) and fiber count specified in the Plans.

2. Assembly Construction

Provide a drop cable assembly as specified in the Plans and meeting the following requirements. Use only drop cables that are factory pre-terminated, that use splice-on factory-connectorized pigtailed/FDC interconnect cables, or are included in pre-terminated FDCs. For factory pre-terminated drop cable assemblies, label each individual fiber with its drop cable fiber number ("1," "2," etc.) on a self-laminating clear overwrapping label on the fan-out tubing within 2 in. (50 mm) of the terminating fiber connector.

- a. Pre-terminated Drop Cable Assembly: Install pre-terminated drop cable assemblies with loose tube design fiber optic cable, factory-installed fiber optic connectors in accordance with Subsection 935.2.F on each drop cable fiber, and factory-assembled fan outs with 3 mm fan out tubing. Use metallic crimps between the drop cable strength members and the fan out tubing strength members, and use heat-shrink tubing seals.
- b. Field-spliced Drop Cable Assembly: Install field-spliced drop cable assemblies with loose tube design fiber optic cable, fusion spliced factory-connectorized pigtails/FDC interconnect cables, in accordance with Subsection 935.2.D and Subsection 935.2.F on each drop cable fiber.
- c. Fan Out - Loose Tube Cable Design: Install field-installed fan outs with 3 mm fan out tubing in accordance with Subsection 935.3.05.J. Additionally, secure the fan out tubing to the main cable sheath in a hard epoxy plug transition that extends a minimum of 2.0 in (50 mm) onto the cable and 2.0 in (50 mm) onto the 3 mm tubing.

F. Fiber Optic Connectors

Furnish and install ST compatible connectors unless otherwise specified, except furnish and install LC compatible connections to optical interfaces on network and field switches. Use ceramic ferrule ultra polish connectors (UPC) for single-mode and multi-mode applications for all connector types. Install connectors as per manufacturer application and recommendations, including proper termination to the outer-tubing (900 micron tubing, 3 mm fan out tubing, etc.) required for the application.

Use UPC connectors rated for an operating temperature of -40 °F to +167 °F (-40 °C to +75 °C).

Use only factory-installed UPC connectors for all applications except where shown in the Plans for specifically permitted applications in accordance with 935.2.E.2. Use factory-installed UPC connectors installed with a thermal-set heat-cured epoxy and machine polished mating face. Do not use field-installed fiber optic connectors.

Where barrel couplers are used in passive termination applications such as FDCs, use only ST compatible ceramic-insert couplers. Use only manufacturer recommended single-mode couplers for single-mode connector applications. Provide dust caps for both sides of couplers at all times until permanent connector installation.

Provide connectors listed below that do not exceed the maximum loss listed for each connector.

Connector Type	Installation	Max. Loss	Typical Loss	Optical Return Loss
Multimode	Factory	0.50 dB	N/A	N/A
Single-mode	Factory	0.50 dB	0.25 dB	>55 dB

G. Splice Closure - Underground

- 1. Use

Install closures designed for use under the most severe conditions such as moisture, vibration, impact, cable stress and flex temperature extremes. Splice closures shall pass the factory test procedures and minimum specifications listed below:

- 2. Physical Requirements

Use a cylindrical closure or rectangular dome type closure with cable entry at one end only and a sealed one-piece high-density polyethylene dome body.

Splice closures shall be suitable for ECB or pull box applications as shown in the Plans..

Ensure that the closure prevents the intrusion of water without the use of encapsulate.

Ensure that the closure's cable entry end has a flexible thermoplastic rubber end seal with pre-template cable ports.

The closure size shown in the Plans specifies the number of splices to be accommodated by the closure. With the closure, provide all materials to accommodate the number of splices specified by the closure size, including splice tray, storage, and organizing materials.

Provide a closure that is capable of accommodating splice organizer trays that accept mechanical, fusion, or multi-fiber array splices. Use a splice closure that has provisions for storing fiber splices in an orderly manner, mountings for splice organizer assemblies, and space for excess or non-spliced fiber. Use splice organizers that are re-enterable and resealable.

Use only UL rated splice cases. Where high fiber count (144 to 432) splice cases are required, use cases that have an external pressurization port for optional pressurization.

Verify that closure re-entry and subsequent reassemble does not require specialized tools or equipment. Further, these operations cannot require the use of additional parts.

Provide a splice closure with provisions for controlling the fiber bend radius to a minimum of 1.5 in (38 mm).

All closures up to the 48-fiber size as shown in the Plans shall have maximum dimensions of 6.5 in. (165 mm) diameter and 23 in. (580 mm) length and shall provide entry of at least four cables of at least 0.75 in. (19 mm) diameter. These closures shall allow for the storage and express of at least 12 unopened buffer tubes when configured for any number of splices up to 48.

All closures above the 48-fiber size and up to the 144-fiber size as shown in the Plans shall have maximum dimensions of 8.5 in. (216 mm) diameter and 30 in. (760 mm) length and shall provide entry of at least four cables of at least 1.0 in. (25 mm) diameter and at least two additional cables of at least 0.75 in. (19 mm) diameter. These closures shall allow for the storage and express of at least 24 unopened buffer tubes when configured for any number of splices up to 144.

3. Quality Assurance Requirements

Install only underground splice closures that pass the following factory testing:

a. **Compression Test:** Provide a closure that does not deform more than 10% in its largest cross-sectional dimension when subjected to a uniformly distributed load of 300 lbf (1.3 kN) at a temperature of 0 °F and 100 °F (-18 °C and 38 °C). Perform the test after stabilizing at the required temperature for a minimum of two hours. Place an assembled closure between two flat paralleled surfaces, with the longest closure dimension parallel to the surfaces. Place the weight on the upper surface for a minimum of 15 minutes. Take the measurement with weight in place.

b. **Impact Test:** Provide an assembled closure capable of withstanding an impact of 21 ft-lb (28 N•m) at temperatures of 10 °F and 100 °F (-12 °C and 38 °C). Perform the test after stabilizing the closure at the required temperature for a minimum of 2 hours. The test fixture shall consist of 20 lb (10 kg) cylindrical steel impacting head with a 2 in (50 mm) spherical radius at the point where it contacts the closure. Drop it from a height of 12 in (0.30 m). Ensure that the closure does not exhibit any cracks or fractures to the housing that would preclude it from passing the water immersion test. There shall be no permanent deformation to the original diameter or characteristic vertical dimension by more than 5%.

c. **Cable Gripping and Sealing Testing:** The cable gripping and sealing hardware shall not cause an increase in fiber attenuation in excess of 0.05 dB/fiber at 1550 nm when attached to the cables and the closure assembly. Test by measuring six fibers, one from each buffer tube or channel, or randomly selected in the case of a single fiber bundle. Take measurements from the test fibers, before and after assembly to determine the effects of the cable gripping and sealing hardware on the optical transmission of the fibers.

d. **Vibration Test:** Provide splice organizers that securely hold the fiber splices and store the excess fiber. Use fiber splice organizers and splice retaining hardware tested per EIA Standard FOP-II, Test Condition I. The individual fibers shall not show an increase in attenuation in excess of 0.1 dB/fiber.

e. **Water Immersion Test:** Provide a closure capable of preventing a 10 ft (3 m) water head from intruding into the splice compartment for a period of 7 days. Ensure that testing of the splice closure has been accomplished by the placing of the closure into a pressure vessel and filling the vessel with tap water to cover the closure. Apply continuous pressure to the vessel to maintain a hydrostatic head equivalent to 10 ft (3 m) on the closure and cable. Continue this process for 7 days. Remove the closure and open to check for the presence of water. Any intrusion of water in the compartment containing the splices constitutes a failure.

H. Splice Closure - Aerial

1. Use

Design the closure for use in aerial applications and to conform to the requirements below:

2. Physical Requirements

Use a cylindrical closure or rectangular dome type closure with cable entry at one end only and a sealed one-piece high-density polyethylene dome body.

Design the closure for free breathing splice protection without the use of encapsulate.

Provide a closure with fully assembled weather tight closure design.

Ensure that the closure's cable entry end has a flexible thermoplastic rubber end seal with pre-template cable ports.

The closure shall have corrosion resistant aluminum or stainless steel hardware. Design the aerial closure in such a way as to allow complete splice access after closure placement, without removal of the closure or electrical bonds from the cable. The closure shall be suitable for straight, butt or branch splices. Include provisions for strain relief, both around the cable jacket and to internal cable strength members. The aerial closure design shall eliminate the need for drip collars and sealing collars. Package the closure with all necessary hardware for aerial mounting.

The closure size shown in the Plans specifies the number of splices to be accommodated by the closure. With the closure, provide all materials to accommodate the number of splices specified by the closure size, including splice tray, storage, and organizing materials.

All closures up to the 48-fiber size as shown in the Plans shall have maximum dimensions of 6.5 in. (165 mm) diameter and 23 in. (580 mm) length and shall provide entry of at least four cables of at least 0.75 in. (19 mm) diameter. These closures shall allow for the storage and express of at least eight unopened buffer tubes when configured for any number of splices up to 48.

All closures above the 48-fiber size and up to the 144-fiber size as shown in the Plans shall have maximum dimensions of 8.5 in. (216 mm) diameter and 30 in. (760 mm) length and shall provide entry of at least four cables of at least 1.0 in. (25 mm) diameter and at least two additional cables of at least 0.75 in. (19 mm) diameter. These closures shall allow for the storage and express of at least 12 unopened buffer tubes when configured for any number of splices up to 144.

3. Optical Fiber Organizer

The fiber organizer is a system that holds splice or organizer trays in such a way as to protect and support cable splices within an environmentally protected area. Provide organizer trays capable of storing all common splices; fusion and mechanical, in all configurations; butt, inline and branch (with up to four branch cables). All trays shall be completely re-enterable. Provide only trays able to accept both multi-mode or single mode fibers. The organizer itself shall accept a minimum of four trays, and offer bonding and grounding hardware. The organizer shall offer a simple one piece cable strapping system.

I. Mechanical Lab Splice

Insertion Loss:

Multi-Mode < 0.30 dB

Single Mode < 0.30 dB

Operating Temperature:

-23 °F to 77 °F (-31 °C to 25 °C)

J. Fiber Distribution Center (FDC)

Use rack-mount, wall-mount, or pre-terminated FDCs as specified in the Plans. Use rack-mount, wall-mount, or pre-terminated FDCs in all field cabinets, including all types of ITS and traffic signal cabinets, unless specifically excepted in the Plans.

Use rack-mount and wall-mount FDCs and FDC splice cabinets with enclosures and mounting components of metallic construction. Use FDC interconnect cable for all OP cable terminations in rack-mount and wall-mount FDCs unless otherwise specified in the Plans.

Use rack-mount FDCs that fit standard 19 inch EIA equipment racks or cabinets.

Use rack-mount FDCs of specified sizes 6-fiber through 24-fiber that have front-opening swing-out drawers for access to the fiber splicing trays and the fiber termination couplers. When closed, the swing-out drawer shall provide a dust-tight seal that completely encloses the fiber splicing trays, fiber termination couplers, and the connecting ends of fiber patch cords connected to the couplers.

Use rack-mount FDCs of specified sizes 36-fiber through 96-fiber that have fixed-mounted front-facing fiber termination couplers accessible behind a removable transparent plastic dust cover.

Use rack-mount FDCs of specified sizes 6-fiber through 48-fiber that include fiber splicing trays integral to the FDC enclosure, accessible through the rear of the FDC or through the swing-out drawer. Use rack-mount FDCs of specified sizes 6-fiber through 24-fiber with a maximum horizontal depth of 14 in (0.35 m) and 30-fiber through 48-fiber with a maximum horizontal depth of 24 in (0.61 m) and of the following maximum vertical heights:

- 6-fiber and 12-fiber: 1.75 in (44.5 mm)
- 24-fiber: 3.50 in (88.9 mm)
- 36-fiber and 48-fiber: 7.00 in (178 mm)

Use rack-mount FDCs of specified sizes 60-fiber through 144-fiber that include a separate FDC splice cabinet installed adjacent to the FDC. Alternately, rack-mount FDCs with splice cabinets integral to the overall FDC enclosure but contained in a separated compartment either above or below the FDC termination couplers. Use rack-mount FDCs of specified sizes 60-fiber through 144-fiber with a maximum horizontal depth of 24 in (0.61 m) and of the following maximum vertical height, combined FDC and FDC splice cabinet of 17.50 in (445 mm).

Provide rack-mount and wall-mount FDCs with the appropriate quantity of couplers, panels, splice trays, organizers, factory-connectorized pigtails/FDC interconnect cables, and ancillary materials to terminate the number of fibers as specified by the FDC size, regardless of the cable size to be terminated as shown in the plans. Use only FDC interconnect cables for FDCs 30-fiber and larger. Where factory pre-terminated drop cable assemblies are permitted and to be used, do not provide splice trays.

Use Type A pre-terminated FDCs that are factory manufactured assemblies of fiber optic drop cable with factory-installed fiber connectors and integral ruggedized fiber connector enclosures. Use Type A pre-terminated FDCs of the sizes specified in the Plans. Use fiber optic drop cable in accordance with 935.2.B and 935.2.E. Use fiber optic connectors in accordance with 935.2.F. The size of the pre-terminated FDC is defined by the number of fibers in the drop cable, all of which shall be connectorized. Use ruggedized fiber connector enclosures of thermally stable rigid plastic housings fully potted with a thermally stable epoxy filling that encapsulates the drop cable fan out, fibers and connector bodies. Use permanent labels on the enclosure with contrasting color to identify each connector body by its associated fiber number. Provide a unique serial number permanently attached on each pre-terminated FDC. Provide a non-metallic cable strain-relief boot where the drop cable enters the fiber connector enclosure and that secures the cable and to the enclosure; the strain-relief boot shall fully encircle the cable for a minimum of 2 inches (51 mm) from the enclosure's outer surface. Use fiber connector enclosures that are no more than 2 inches (51 mm) wide and deep (the maximum dimension of the enclosure plus fiber connector body). Use 4 fiber and 6 fiber enclosures that are no more than 11 inches(280 mm) long and 12 fiber enclosures that are no more than 14 inches (356 mm) long. All fiber connectors shall be arranged on one of the long (vertical) faces of the enclosure. Provide an 0.125 in. (3.175 mm) thick aluminum mounting plate that secures to the fiber connector enclosure. The mounting plate shall have at least four mounting holes near the plate's corners that permit horizontal or vertical mounting flush to a panel, and are spaced appropriately for vertical mounting to an EIA equipment rack rail using two of the mounting holes.

For FDCs of all types, provide couplers with dust caps in accordance 935.2.F. Use only ST compatible couplers unless otherwise specified.

K. Transceivers

1. External Transceiver

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Provide external transceivers that meet the following requirements:

- Daisy chained, linear multi-drop configuration.
- Asynchronous, full duplex RS 232 communication.
- Meet NEMA TS-1-1989 (R1994, R2000, R2005) environmental standards for power interruption, temperature and humidity, power service transients, non-destruct transients, vibration and shock. Conformance with equivalent environmental standards by other entities may be submitted for consideration.
- External, female ST connectors with T1, R1, T2, R2 ports for fiber connection.
- External female DB-25, DB-9, or terminal block RS 232 connector.
- External indicator LEDs for power, transmit & receive (each channel).
- Multimode transceiver operates at 1300 nm (minimum 14 dB power budget).
- Single mode transceiver operates at 1310 nm (minimum 21 dB power budget).
- Receiver dynamic range that is a minimum of 2 dB greater than the manufacturer's specified power budget. The transceiver shall fully maintain all operational performance characteristics throughout the full receiver dynamic range, including a 0 dB path loss.
- Anti-streaming communications.
- Single mode transmitter units incorporate laser diode optical emitters.
- Internal, nickel-cadmium trickle charge battery for a minimum of six (6) hour backup operation. The battery shall be designed to have minimized degradation to reliability during extended periods of trickle charge operation. Use corrosion resistant battery contacts.
- Metal housing with maximum dimensions of 8" x 5" x 2" (200 mm x 130 mm x 50 mm). The metal housing shall have flanged mounting brackets to allow for permanent mounting with screws.

Do not use internal card-type units in field devices, such as traffic signal controllers, CCTV system controllers, and changeable message sign controllers.

Provide external transceivers in the control center or communications hub that meet the additional following requirements:

- Permanently rack mounted within a card cage with a self-contained rack power supply
- Card cage shall be provided per project requirements.

2. External Star Transceiver

Provide an RS232 data optical star transceiver meeting all requirements of the external transceiver in Subsection 935.2.K.1 with the following modifications:

The star transceiver shall be designed for multi-drop configuration with three optical data ports and one electrical equipment data connection port, to be applied in a drop-and-repeat optical three-way to "T" installation.

Verify that the star transceiver is fully compatible and operable with the linear drop-and-repeat transceiver specified in Subsection 935.2.K.1.

Do not include internal battery for backup operation.

L. Fiber Optic Snowshoes

Use fiber optic snowshoes that are factory-manufactured fiber optic cable storage brackets designed for aerial installation on messenger wire cable support spans. Provide fiber optic snowshoes constructed with aluminum or plastic bodies that maintain a minimum of an 8 inch (203 mm) cable bending radius and have integral cable lashing strap slots or holes for secure cable attachment to the storage bracket. Ensure that plastic snowshoe components are 100% carbon filled for resistance to UV exposure. Provide a minimum of two stainless steel or hot-dipped galvanized span wire mounting clamps for attachment.

935.2.02 Delivery, Storage, and Handling

Package the cable for shipment on reels. Each package shall contain only one continuous length of cable. Construct the packaging so as to prevent damage to the cable during shipping and handling.

Seal both ends of the cable to prevent the ingress of moisture.

Include with each reel a weatherproof reel tag attached identifying the reel and cable that can be used by the manufacturer to trace the manufacturing history of the cable and the fiber.

Include with each cable a cable data sheet containing the following information:

- Manufacturer name
- Cable part number
- Factory order number
- Cable length
- Factory measured attenuation of each fiber
- Bandwidth specification (where applicable)
- Index of refraction

When the length of an order requires a reel greater than 3 ft (0.9 m) in diameter, apply a protective coating around the cable before shipment. Cover the cable with a thermal wrap. Securely fasten the outer end of the cable to the reel head so as to prevent the cable from becoming loose in transit. Project the inner end of the cable a minimum of 6.5 ft (2.0 m) into a slot in the side of the reel or into a housing on the inner slot of the drum, in such a manner to make it available for testing.

Plainly mark each reel to indicate the direction in which it is to be rolled to prevent loosening of the cable on the reel.

935.3 Construction Requirements

All fiber optic parts, materials, components and equipment installed on this contract shall be consistent and compliant with the latest version or edition of the standards and industry practices specified in Section 935.1.02.B. If a conflict of difference exists between the requirements contained in the specified standards and practices and the requirements contained in these Specifications, then the Contractor shall use the most stringent material requirement for this contract. The Contractor shall notify the Engineer of any such conflicts or differences prior to procurement of materials and components.

935.3.01 Personnel

A. Section deleted

935.3.02 Equipment

Furnish a portable fiber optic light source and power meter test set for testing the fiber optic cable. Provide a test set matched, calibrated and referenced to work as a synchronized test system. Include 850 and 1300 nm light sources by LED and 1300 and 1550 nm light source by laser. Provide a power meter capable of measuring the optical loss from all of the above sources.

Provide a power meter capable of a resolution of at least 0.1 dB and a power range of at least +10 to -60 dB. Provide connectors and adapters for ST and duplex SC connectors. The light sources and power meter shall be capable of 120 VAC line power or rechargeable battery power. Provide a portable battery-operated printer for direct reports of test measurements, and provide PC software for uploading and storing test measurements on a computer. Provide protective padded carrying cases for all test set components, including test cables and adapters. Include complete instruction and training in the use of the test set in the training required in Subsection 935.3.08. This equipment shall remain the property of the Contractor.

935.3.03 Preparation

Not applicable

935.3.04 Fabrication

A. Fiber Optic Connectors

Furnish and install connectors with ceramic ferrules, with the fibers permanently secured within the ferrule with epoxy, heat set or air dried, as specified by the connector manufacturer.

Install connectors according to the manufacturers recommended practice.

935.3.05 Construction

A. OSP and IP Cable Installation

Submit for approval a detailed construction and installation procedure (SOP) covering all aspects of the construction and installation process for each and all specific cable to be used on this project. Secure from the cable manufacturer the construction and installation procedures to be used on the project. The SOP shall be submitted for review by the Engineer. Maintain traffic control that adheres to Section 150 of the Georgia Standard Specifications.

B. Cable Installation Procedures and Standards

1. Safety Precautions

Follow all appropriate OSHA and industry standards related to safety when working in manholes or underground vaults and when handling optical fibers.

2. Cable Handling

Install all fiber optic cable according to the manufacturer's recommended procedures and these specifications.

3. Pulling Tension

Do not exceed the maximum recommended pulling tension during installation as specified by the cable manufacturer.

4. Allowable Bend Radius

Do not violate the minimum recommended bend radius during installation as specified by the cable manufacturer. Unless the manufacturer's recommendations are more stringent, use the following guidelines for minimum bend radius:

20 X Cable Diameter	Short Term - During Installation
10 X Cable Diameter	Long Term - Installed

5. Cable Installation Guidelines

Before the installation begins, carefully inspect the cable reels for imperfections such as nails that might cause damage to the cable as it is unreeled.

Take all necessary precautions to protect reeled cable from vandals or other sources of possible damage while unattended. Any damage to the cable sections may require replacement of the entire section.

Whenever unreeled cable is placed on the pavement or surface above a manhole, provide means of preventing vehicular or pedestrian traffic through the area in accordance with Section 150 of the Specifications.

Use the "figure-eight" cable lay configuration to prevent kinking or twisting when the cable is unreeled or backfed. Do not coil fiber optic cable in a continuous direction except for lengths of 100 ft (30 m) or less. The preferred size for the "figure-eight" is 15 ft (5 m) in length, with each loop 5 ft to 8 ft (1.5 m to 2.4 m) in diameter. When "figure-eighting" cable, exercise care to relieve pressure on the cable at the crossover of the eight. This may be done by placing cardboard shims at the crossover or by forming a second "figure-eight".

Keep the cable continuous throughout the pull. Cable breaks are allowed only at designated splice points.

Where messenger cable is required, as shown in the Plans, lash aerial fiber optic cable to a steel strand wire messenger cable of the size specified in the plans that conforms to Georgia Standard Specification 915.02.

6. Cable End Sealing

Where a cable ends without termination in a fiber optic closure, seal the end of the cable by re-using a cable end cap that is shipped with a cable reel. Use a cap that is size-matched to the cable to be sealed. Clean the end of the cable. Partly fill the cap with a waterproof silicone adhesive sealant and press the cap fully onto the cable end, rotating the cap to fully encapsulate the cable end with the sealant in the cap. Apply a full sealant bead between the end of the cap and the cable jacket.

C. Cable Storage

At designated intervals throughout the cable plant, pull and store excess cable for slack for future terminations or splicing.

1. Cable Storage Requirements - Underground (OSP) & IP

Unless otherwise noted on the plans, the following are the requirements for cable storage for underground and IP applications:

- Pull Box – (Types 4, 4S, 5, 5S, 6, and 7) Apply the following storage requirements for the indicated cable/closure situations.
 - Drop cable with no closure – 10 ft. (3 m)
 - One or more trunk cables with no closure – 110 ft. (34 m) of each cable
 - Two or more trunk cables with one closure – store 55 ft. (17 m) of each trunk cable so that the closure can be removed from the pull box approximately 55 ft. (17 m). If a drop cable is spliced to the trunk cable at this point, store 55 ft. (17 m) of each drop cable.
 - One trunk cable with one closure – 110 ft. (34 m) Install closure in the center of the 110 ft. (34 m) cable loop, so that the closure can be removed from the ECB approximately 55 ft. (17 m). If a drop cable is spliced to the trunk cable at this point, store 55 ft. (17 m) of each drop cable.
 - One trunk cable with one closure and trunk cable ends – 95 ft (30 m). Install closure on the trunk cable at 55 ft (17 m) from the pull box. If a drop cable is spliced to the trunk cable at this point, store 55 ft (17 m) of each drop cable.
 - Trunk cable ends with no closure – 95 ft. (30 m)

Hub Building (*interior*) – Do not store slack cable inside the hub building.

Hub Building (*exterior adjacent ECBs*) – 180 ft (55 m)

- Traffic Control Center & Transportation Management Center (OSP splice vault) – 65 ft (20 m)
- Traffic Control Center & Transportation Management Center (IP at equipment room) – cable entrance to distribution panel bay plus 20 ft (6 m)

- Electrical Communication Box (ECB) - (Types 3, 4, 5, and 6) Apply the following storage requirements for the indicated cable/closure situations. More than one situation may occur in a single electrical communication box, in which case apply each appropriate requirement.
 - Trunk cable with no closure – 110 ft (34 m)
 - Trunk cable with one closure – 110 ft (34 m). Measure the storage amount from the top of the ECB manhole opening. Install closure in the center of the 110 ft (34 m) cable loop, so that the closure can be removed from the ECB approximately 55 ft (17 m). If a drop cable(s) is spliced to the trunk cable at this point, store 55 ft (17 m) of each drop cable.
 - Trunk cable with one closure and trunk cable ends – 95 ft (30 m). Install closure at 55 ft (17 m) from the ECB on the trunk cable. If a drop cable(s) is spliced to the trunk cable at this point, store 55 ft (17 m) of each drop cable.
 - Trunk cable ends with no closure – 95 ft (30 m)

2. Minimum Cable Storage Requirements - Aerial Applications

Unless otherwise noted on the plans, the following are the minimum requirements for cable storage for aerial applications:

Install a minimum 150 ft (45 m) storage loop approximately one half the distance between every equipment drop or as shown in the Plans. Where equipment drops are greater than 1000 ft (300 m) apart, install a minimum 150 ft (45 m) storage loop for every 1000 ft (300 m) of uninterrupted cable length.

At aerial splice closures, install 75 ft. (23 m) of drop cable storage and 150 ft. (45 m) of trunk cable storage, unless otherwise noted in the Plans, to allow the fully assembled closure, including the trunk cable and drop cable, to be lowered to ground level for maintenance purposes.

3. Cable Storage

Properly store all cable to minimize susceptibility to damage. Maintain proper bend radius, both short and long term, during cable storage.

- a. Communication and Pull Boxes: Store the excess or slack cable in the pull box or communication box in accordance with the Plans details.
- b. Hub/TMC/TCC: Properly store the cable in cable troughs and plenum applications which meet NEC requirements.
- c. Aerial Installations: Store the excess or slack cable at storage loops in a “bow tie” configuration on the messenger strand using two fiber optic snowshoes (aerial fiber cable storage brackets) that maintain the proper bend radius in the fiber cable. Install one fiber optic snowshoe for drop cable and trunk cable storage at aerial splice closures to maintain the proper bend radius in the fiber optic cable.

D. Cable Splicing

Splice together each individual reel of fiber optic cable that makes up the continuous length of installed cable called for on this Project. Splice cable only at splice points designated on the plans. Make no splices within a patch cord assembly or drop cable.

E. Mid Span/Drop Access

At points where mid span/drop access is required, keep all fibers intact except those that are being accessed for the equipment drop. Use a suitable tool for removing fibers from the buffer tube to prevent damage to the fibers that will remain intact.

F. Connector Termination Procedures

Only use procedures for the termination of the connectors that meet the process set out in that connector manufacturer's standard operating procedure (SOP) for the field installation.

G. Cable Marking

1. Materials

Use 2-1/2" (63.5 mm) wide, 4" (100 mm) long, wrap-around type cable markers suitable for underground and aerial use. Use UV stabilized marker material and printing inks to provide an aerial durability of at least five years.

Print text in bold black type on orange or yellow PVC markers, as specified in Section 935.3.05.G.2. Use base material that is minimum 0.015" (0.38 mm) thickness PVC. Pre-print the following text, or alternate text shown in the Plans, legibly on markers used for all cables:

Cable ID: XXXXXXXX
GA DOT
Optical Cable

Where XXXXXXXX is the appropriate cable ID as defined in the Plans. Print the text specified above twice on every cable marker with the text of the second image reversed and abutting the first image. The end result shall be text which "reads right" when either short edge of the cable marker is held horizontally upright.

2. Installation

Clean the installed cable of all dirt and grease before applying any marker. Follow the marker manufacturer's recommended procedure for applying cable markers. Mark all cables in or at every communications hub, electrical communications box, pull box, handhole, equipment cabinet, aerial or underground splice closure, pole attachment, aerial storage bracket, and pole conduit riser entrance. At every trunk cable termination, reel end-to-reel end splice, electrical communications box, pull box, handhole, equipment cabinet, aerial splice closure, and aerial storage bracket, record the cable distance markings from the printline for the cable entry and exit, along with the exact location by Station Number or location name. Record the cable distance markings in a tabular format approved by the Engineer or on a documentation form provided by the Department.

Place cable markers in the following locations:

- within 18 in (460 mm) of every cable entry to a pull box, handhole, ECB and hub building
- within 6 in (150 mm) of every cable entry or termination in an equipment cabinet
- within 18 in (460 mm) of every splice closure at cable entry points
- within 6 in (150 mm) of every FDC or splice cabinet in a hub building in which a cable terminates or enters
- every 20 ft (6 m) for the length of a cable in maintenance coils in electrical communications boxes or pull boxes
- within 12 in (0.30 m) of every pole attachment, aerial storage bracket, and pole conduit riser entrance

Use orange markers at all locations, except as noted below:

- Where a trunk cable enters and leaves a closure (mid-span cable entry or end-to-end splice), use orange markers for one leg of the trunk cable and yellow for the other leg, placing corresponding color labels at the closure end of a leg and at the conduit entrance (underground installation) or span attachment (aerial installation).
- Where two drop cables terminate in a closure, use orange markers for one drop cable and yellow markers for the other drop cable, throughout the entire drop cable's length to its other termination.

H. Fusion Splicing

1. Use

Unless otherwise noted, fusion splice all fiber optic splices.

2. Procedure

Fusion splicing consists of aligning the cores of two clean, cleaved fibers or a group of such fibers and fusing the ends together with an electric arc. Position the fiber ends under a microscope or a high-resolution video monitor and then align them using precision movement micro-positioners. High-voltage electrodes contained in the splicer conduct an arc across the fiber ends as the fibers are moved together, thus fusing the fibers together. Verify maximum core alignment prior to splicing and estimate splice loss after the fusion process by the use of light injection and detection devices or profile alignment algorithms.

Install all splice enclosures according to the manufacturer's recommended guidelines.

3. Splice Protection

Adequately protect all fusion splices in splice trays or organizers in an enclosure. When splicing inside a building, use a splice center where rack or wall space is available.

Provide the splice with strain relief and protection of the stripped fiber splice in a manner recommended by the splice tray or organizer manufacturer. Use splice types compatible with the tray design.

Protect fusion splices with a heat shrink tubing that protects the splice and extends over the fiber coating. No bare fiber may be exposed.

I. Mechanical Splicing

1. Use

Do not use mechanical splices for any purpose other than a temporary connection to fiber optic test equipment.

2. Procedure

Make all mechanical splices of the strain relief/locking type requiring no adhesive or polishing of the fiber ends. Ensure the fibers are self-aligning upon the closing of the mechanical splice. The splices shall have the capability of splicing multi-mode or single mode fiber, and with any combination of buffer coating (250 μm and 900 μm). The splice shall be of one piece construction. Ensure that there is no stress on the fiber in the alignment area.

Install all splice closures according to the manufacturer's recommended guidelines.

3. Lab Splice

Use a mechanical fiber optic lab splice when a temporary joining of two fibers is required, such as in the testing of non-terminated fiber. These splices may be used on single mode or multi-mode optical fiber. Ensure the lab splice is re-usable for up to 50 matings. The lab splice shall accommodate optical fibers with cladding diameters between 120 and 145 μm .

J. Splice Closures

Install splice closures according to all manufacturers' recommendations. Install splice closures where shown in the Plans and in the approximate center of fiber cable storage coils. All splice closures mounted in ECBs or pull boxes shall be securely mounted to cable rack hooks or mounting brackets.

K. Fiber Optic Cable Fan Out

1. Inside Plant

Provide all inside plant cable with a fan out in accordance with the manufacturer's recommended guidelines. In protected environments such as a splice case, protect the fiber with a minimum 900 μm jacket. In all other instances, protect the fiber with 3 mm fan out tubing. Install only connectors meeting the requirements for connectors set forth in Subsections 935.3.04.A and 935.2.F.

2. Outside Plant

Up-jacket individual 250 or 900 micron fibers to 3 mm using fan out tubing. Include in the fan out tubing aramid yarn strength members and an outer protective jacket. The individual leg length shall be 3 ft +/- 2 in (0.9 m +/- 50 mm).

L. Temporary Fiber Optic Cable

Furnish and install one continuous temporary fiber optic cable system as shown in the Plans. Terminate the cable and patch cords as required in the Plans, splice the cable along cable route at the points indicated in the Plans.

M. External Transceivers

Shelf mount external transceivers in a manner that does not restrict the replacement of other components in the cabinet housing. In Type 170 traffic cabinets mount the transceiver on an aluminum shelf permanently attached to the EIA 19" cabinet rack in the rear of the cabinet.

N. Fiber Distribution Center (FDC)

Do not install mechanical splices or field installed connectors. Equip unused panel slots with blank panels. Provide inter-cabinet and inter-bay bend radius and jumper management on each side of the FDC. Install all hardware according to the manufacturer's recommended procedures and Department standards. Determine specific hardware sizing from the project documents.

For rack-mount and wall-mount FDCs, array connectors in a vertical pattern with number one being at the top left position.

Prior to manufacture of pre-terminated FDCs, verify the final installed location of all portions of each drop cable route from the splice closure to the equipment cabinet (including but not limited to the cabinet location, all conduit and pullboxes, and the splice closure location) to determine the required length of drop cable, including all splice closure and storage coils, to be factory manufactured with each FDC. In Type A Equipment Cabinets, mount pre-terminated FDCs on the side panel in a vertical position, as shown in the equipment cabinet details. Mount the pre-terminated FDCs with the connectors horizontal or facing downward, and route the drop cable up or down as necessary. Route and secure the drop cable beside or behind the cabinet side panel such that it is fully strain-relieved, does not violate the manufacturer's recommended bending radius, and does not interfere with the operation of or access to any cabinet equipment or electrical components.

935.3.06 Quality Acceptance

A. Underground Splice Closures

Ensure that an independent testing laboratory has performed all tests described in Subsection 935.2.G. Provide certification from an independent testing laboratory as required in Subsection 935.3.1.

B. Fiber Optic Cable

1. Installation Test

Test the fiber optic cabling installed on this project according to the fiber's assigned use as shown in the plans and as defined below:

- **Terminated Fibers:** terminated fibers are defined as fibers that are terminated on both ends, providing an end-to-end link from the hub to a device or between devices
- **Spare Fibers:** spare fibers are defined as fibers not being connected with this project to a device and that may be terminated at one end and stored at the other end, or stored at both ends. Spare fibers may or may not be spliced through two or more different trunk cables.

Upon completion of the cable installation, splicing, and termination, and a minimum of fourteen days before equipment hookup, test all terminated fibers and spare fibers for continuity, events above 0.10 dB, and total attenuation of the cable. In the event that fiber optic cable installed on this project is connected to existing fiber optic cable, perform installation testing on both terminated fibers and spare fibers of the new cable and existing fibers to which the new fibers are spliced or connected. Submit both printed and electronic (diskette) OTDR traces as specified in Subsection 935.1.03. Submit copies of the cable distance marking documentation as required in 935.3.05.G.2.

2. Test Requirements

- a. OTDR Test: For all single mode and multi-mode fiber links, test and document the installation using OTDR testing.

A certified technician shall conduct the installation test using an optical time domain reflectometer (OTDR) and optical source/power meter. The technician is directed to conduct the test using the standard operating procedure as defined by the manufacturer of the test equipment. The OTDR to be used shall be capable of performing standard OTDR functions, including the ability to display individual loss/gain in dB per km, as well as display all 2-point dB loss cursors to allow isolating and viewing any and all points along a given fiber distance.

Use a factory patch cord of a length equal to the "dead zone" of the OTDR to connect the OTDR and the cable. Optionally, the Technician can use a factory "fiber box" of 325 ft (100 m) minimum with no splices within the box.

Conduct the tests at 1300 nm for multimode cable and at 1310/1550 nm for single mode cable.

- b. Attenuation Test: For all single mode and multi-mode fiber links, test and document attenuation by a standard power-meter test.

For every fiber installed or connected to under this Contract, perform end-to-end attenuation test. For the test, use a calibrated optical source and power meter using the standard three-stage procedure. Determine acceptable link attenuation by the cumulative value of standard losses based on length, number and type of splices and connectors.

3. Fiber Optic Cable Acceptance

Use the following criteria for acceptance of the cable:

Provide test results demonstrating that the dB/km loss does not exceed +3% of the factory test or 1% of the cable's published production loss. Consider the error rate for the test equipment in the test.

No event can exceed 0.10 dB. If any event is detected above 0.10 dB, replace or repair that event point.

The total dB loss of the cable, less events, cannot exceed the manufacturer's production specifications as follows:

Cable Type	Max. Attenuation dB/km	Test Wavelength
Singlemode	0.30	1550 nm
	0.40	1310 nm
Multimode	1.0	1300 nm

If the total loss exceeds these specifications, replace or repair that cable run and assume all expenses, both labor and materials. Elevated attenuation due to exceeding the pulling tension during installation will require the replacement of the cable run at no expense to the Department for either labor or materials.

NOTE: The Department may allow the "bi-directional/averaging" process of OTDR testing, particularly when splice losses are being unfavorably affected by "mode field diameter misalignment," "core off-set" or "core misalignment."

C. Fusion Splicing

Ensure that the maximum splice loss for any fusion splice does not exceed 0.10 dB.

D. Mechanical Splicing

Ensure that the maximum splice loss for mechanical splices does not exceed 0.70 dB.

E. Fiber Distribution Center (FDC)

Test all completed and assembled pre-terminated FDCs at the point of manufacture and provide two copies of the manufacturer test documentation. Test each connectorized fiber in the pre-terminated FDC to demonstrate compliance with all requirements for cables and connectors as detailed in other subsections of these specifications. Include in the test documentation the location station number where the FDC is to be installed, the serial number of the pre-terminated FDC, the Office of Traffic Operations

drop cable footage markings at each end of the drop cable, and the total drop cable distance. Place one copy of the manufacturer test documentation in the equipment cabinet drawer where the pre-terminated FDC is installed, and submit the other copy to the Engineer.

935.3.07 Contractor Warranty and Maintenance

Provide a Manufacturer support (usual and customary warranties) period for all fiber optic cable materials furnished and installed as part of the fiber cable system. Include in warranty and support all contractor or manufacturer activities related to maintenance, removal and replacement of cabling, closures and other fiber optic system materials during the period of support. Begin the Manufacturer warranty support period upon successful completion of the Fiber Optic Quality Acceptance testing as outlined in Subsection of 935.3.06. All Manufacturer warranties shall be continuous throughout the period and state that they are subject to transfer to the Department.

935.3.08 Training

Provide both installation and maintenance training on fiber optic cable to selected Department personnel. Personnel trained by the manufacturer of the fiber optic cable furnished on this project and authorized by said manufacturer shall perform the training. Furnish a training notebook in a labeled 3-ring binder to each trainee.

Provide a location to hold the courses that is an acceptable indoor and comfortable location near the project area. If requesting that the training be conducted away from the project area, pay all costs associated with travel and accommodation of all students.

Provide installation and maintenance training for up to eight (8) people. Include in this training both classroom training and hands-on training. All training shall be conducted in half-day sessions. Two half-day sessions may be held on the same day. The training will consist of classroom instruction and field training applications. The contractor shall provide and schedule training at least 5 working days prior to fiber cable being installed on the project. The total of the installation and maintenance training shall consist of at least forty (40) clock hours of training for each participant. Cover all aspects of inside plant and outside plant fiber optic cable installation, maintenance, and trouble-shooting including the use of all recommended test equipment. Ensure that all equipment, materials, and procedures used in the training comply with the requirements of Section 935.

As a minimum, include in the fiber optic training the following:

THEORY

- Light
 - Light transmission through fiber cable with discussion on effect of cable composition.
 - Theory definitions
- Electromagnetic spectrum
 - Composition of light
 - transmission of differing spectrums of light
- Refraction/reflection (Effects of light within fiber cable and relationship of light against core and cladding materials)
- Attenuation (Effects of fiber cable on transmission speeds of light)
- Signal wavelength selection (single-mode, multi-mode)
 - Selection of cable based on application
 - advantages of each cable
- Signal transmission form

- Analog, digital
- Bandwidth

SAFETY

- Working with optical fibers
 - Handling precautions
 - Working with lasers
 - Chemicals used in preparation, maintenance, splicing

ADVANTAGES/DISADVANTAGES

- Comparison of fiber optic cable to copper cable

COMPARISONS

- Fiber optic cable sizes and characteristics (capacities, weights, single-mode, multi-mode)

FIBER

- Types of propagation
- Multi-mode - characteristics and applications MM fiber spools
- Single-mode - characteristics and applications SM fiber spools
- Fiber cross sections, 250 μm and 900 μm fiber
- Fiber characteristics and specifications
- Fiber manufacturing

CABLE

- Loose tube designs, sample cable
- Tight buffer designs, cable samples
- Selection of cable to environment
- Cable for strip/prep for fan-out kit installation

CONNECTORS/COUPLINGS

- Connector designs, connectors/couplings samples
- Connectors in fiber systems
 - Installation of 900 μm fan-outs on loose tube cable, buffer tube fan-out
 - Installation of 3.0 mm fan-outs on central core cable, 3.00 mm fan-out tubing
 - Installation of Spider fan-out on loose tube cable, spider fan-out.
 - Field installation of MM/SM connectors (attendees terminate ends of cables with connectors)

SPLICING

- Fiber preparation and cleaving
- Office of Traffic Operations

- Factors effecting splice loss
 - Splice trays
-
- Splices
 - Fusion and mechanical
 - Mechanical splice installation, mechanical splice demo
 - Fusion splicing class demonstration

DISTRIBUTION HARDWARE

- Distribution equipment (FDC)
- Wall and rack mount distribution equipment
- Field connecting, pigtails
- Field installation of connectors, demonstrate loose tube cable

INSTALLATION/MAINTENANCE

- Installation of outside plant cable (OSP) and closures
- Installation of inside plant cable (ISP)

TESTING AND TROUBLESHOOTING

- Power meter and light source usage, demonstration and test
- Visual fault locator usage, demonstration and test
- OTDR usage, demonstration and explanation of trace results with samples of multi-mode and single mode fiber
- Interpretation of OTDR reports on single and multi-mode fiber

FIBER IN ITS AND TRAFFIC SIGNAL CLOSED LOOP APPLICATIONS

- Typical architectures course book
- Closed loop traffic interconnect, trunk and drop/point to point connection
- CCTV/VDS trunk and drop/point to point
- Overall GDOT system architectures

935.4 Measurement

Fiber optic system, temporary fiber optic system, testing and training that is complete, in place, accepted and of the kind, size, and type specified is measured as follows.

A. Outside Plant Fiber Optic Cable

Outside Plant fiber optic cable is measured for payment by the actual number of linear feet installed, complete, functional, and accepted. Fiber optic cable shall include but is not limited to all required fiber optic connectors, fiber optic snowshoes, marking and labeling, patch cords and other ancillary items as required for a complete fiber optic installation.

B. Inside Plant Fiber Optic Cable

Inside Plant fiber optic cable is measured for payment by the actual number of linear feet installed, complete, functional, and accepted. Fiber optic cable shall include but is not limited to all required fiber optic connectors, marking and labeling, patch cords and other ancillary items as required for a complete fiber optic installation.

C. Closures

Underground splice closures, aerial splice closures, and FDCs are measured for payment by the actual number of units installed, complete, functional and accepted. Closures shall include but are not limited to all required mounting and fastening hardware, fiber optic connectors, FDC interconnect cables/pigtails, marking and labeling, patch cords and other ancillary items as required for a complete closure installation.

D. Fiber Optic Splice, Fusion

Fiber optic splices, fusion, are measured for payment by the actual number of splices made, complete, and accepted. Fiber optic splices associated with the use of factory-connectorized FDC interconnect cables/pigtails on drop cables, in accordance with Section 935.2, will not be measured separately for payment. Mechanical splicing for temporary applications shall be included in other work and will not be measured separately for payment.

E. Temporary Fiber Optic System

Payment for work on the Temporary Fiber Optic System will be a lump sum project bid price and will be considered full compensation for all installed materials and labor associated with the Temporary Fiber Optic System. Specific items include but are not limited to timber poles, guys, anchors, lashing, messenger cable, conduit directional boring, conduit, fiber optic cable, fusion splicing, hardware attachments, splice enclosures, equipment rentals, and disposal of materials.

F. Transceivers

External drop and repeat transceivers and external star transceivers are measured for payment by the number actually installed, complete, functional, and accepted.

For each unit installed, furnish and install all mounting and interconnection materials, including but not limited to card cages, hardware, fiber and RS-232 jumper cables, RS232/485 converters, and power supply cables at no separate cost to the Department.

G. Testing

Testing is measured as a lump sum for full delivery of testing and acceptance requirements. Measurement of testing includes subsistence necessary to conduct the testing.

H. Training

Training is measured as a lump sum for all supplies, equipment, materials, handouts, travel, and subsistence necessary to conduct the training.

935.4.02 Limits

Not applicable

935.5 Payment

Outside and inside fiber optic cable, FDC interconnect cables/pig tails, splice closures, splices, temporary fiber optic system, transceivers, and testing are paid for at the Contract Unit Price for the various items. All other required items including; FDC interconnect cables/pigtails, fan-out kits, fiber optic connectors, fiber optic snowshoes, and other ancillary items for a completed fiber optic system shall be included as part of the below pay items. No separate payment shall be made for these items. Payment is full compensation for furnishing and installing the items complete and in place according to this Specification, with the exception of Training.

Training is paid for on a partial payment basis as follows:

The Department will pay 25% of the total contract bid amount for this item upon approval of the Training Plan. The Department will pay the remaining 75% after completion of all training as described in Subsection 935.3.08. The total sum of all payments cannot exceed the original contract amount for this item. Payment for all items of this Section is as follows:

Payment will be made under:

Item No. 935	Outside Plant Fiber Optic Cable (type, mode, size)	Linear Feet (Linear Meter)
Item No. 935	Inside Plant Fiber Optic Cable (type, mode, size)	Linear Feet (Linear Meter)
Item No. 935	Fiber Optic Closure (type, size)	Per Each
Item No. 935	Fiber Optic Closure, FDC Pre-Terminated (type, size)	Per Each
Item No. 935	Fiber Optic Splice, Fusion	Per Each
Item No. 935	External Transceiver (mode)	Per Each
Item No. 935	External Star Transceiver (mode)	Per Each
Item No. 935	Temporary Fiber Optic System	Lump Sum
Item No. 935	Testing	Lump Sum
Item No. 935	Training	Lump Sum

935.5.01 Adjustments

Not applicable

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA
SPECIAL PROVISION**

P.I. No.: 0010290 & 0010311

**Fulton County
Forsyth County**

Section 936 - Closed Circuit Television (CCTV)

Add the following:

936.1 General Description

This work includes furnishing and installing closed circuit television (CCTV) system, any specified type, which is a CCTV video surveillance field installation, including but not limited to color CCTV cameras, lens, housing, pan/tilt drive, camera system assembly, cabling, mounting hardware, interface panel, camera control receiver, and cabinet wiring. This CCTV system provides operator control from and video imaging to the Department's NaviGator Advanced Transportation Management System (ATMS).

Provide all equipment and materials of like kind and function to be of the exact same manufacture, model, revision, firmware, etc.

Provide all equipment, materials, and work in accordance with all manufacturers' recommendations, including but not limited to all mounting, wiring and cabling, power supply, surge suppression, and communications equipment and materials.

936.1.01 Definitions

CCTV System, Type B – The Type B CCTV System uses a self-contained camera system assembly with an analog NTSC video output and RS-232 serial data control interface.

Type A Cabinet – As specified in Section 939, the Type A cabinet housing is a standard Model 336 stretch (336S) housing with approximate exterior dimensions of 46 in (H) by 24 in (W) by 23 in (D).

Type B Cabinet – As specified in Section 939, the Type B cabinet housing is a standard Model 337 housing with approximate exterior dimensions of 35 in (H) x 20 in (W) x 17 in (D).

Type C Cabinet – As specified in Section 939, the Type C cabinet housing is a standard Model 332 housing with approximate exterior dimensions of 64 in (H) by 24 in (W) by 30 in (D).

Type D Cabinet – As specified in Section 939, the Type D cabinet housing is a standard Model 336 stretch (336S) housing with approximate exterior dimensions of 46 in (H) by 24 in (W) by 23 in (D).

Type E Cabinet – As specified in Section 939, the Type E cabinet housing is a standard Model 336 stretch (336S) housing with approximate exterior dimensions of 46 in (H) by 24 in (W) by 23 in (D).

936.1.02 Related References

A. Georgia Standard Specifications

Section 639 - Strain Poles for Overhead Sign and Signal Assemblies

Section 680 - Highway Lighting

Section 682 - Electrical Wire, Cable and Conduit

Section 922 - Electrical Wire and Cable

Section 923 - Electrical Conduit

Section 925 - Traffic Signal Equipment

Section 939 - Communication and Electronic Equipment

B. Referenced Documents

American National Standards Institute (ANSI)

American Society of Testing and Materials (ASTM)

Electronic Industries Association (EIA)

FCC Rules Part 15, Sub-part J

Insulated Cable Engineers Association (ICEA)

International Municipal Signal Association (IMSA)

MIL-HDBK-454A

MIL-STD-810F(3) Method 509 Procedure 1 – exterior salt atmospheres

National Electric Code (NEC)

National Electrical Manufacturers Association (NEMA)

NEMA-4

Underwriter's Laboratory Incorporated (UL)

National Television Standards Committee (NTSC)

936.1.03 Submittals

This subsection and the following chart provide the Contractor with an outline of the submittal requirements for the equipment and components for all pay items in this Section 936. This chart is to be used as a guide and does not relieve the Contractor from submitting additional information to form a complete submittal package.

Section 936 Submittal Requirements									
Material	Specification Reference	Catalog Cuts	Mfg. Spec.	Materials Cert.	Lab Test	Install. Proced.	Test Plan	Maint. Proced.	Submittal Due Date (Cal. Days after NTP)
Camera System Assembly, Type B	936.2.01.A	X	X	X	X	X	X	X	60 Days
Camera System Assembly Mount, Type B	936.2.01.B	X	X	X		X	X		60 Days
Cabinet Interface Assembly, Type B	936.2.01.C	X	X	X	X	X	X	X	60 Days
Cabling and Connectors, Type B	936.2.01.E	X	X	X		X	X		60 Days
CCTV System, Type B, Demonstration Test Set, Documentation and Equipment List	936.1.03.A.5						X		60 Days
Training Plan	936.3.08		X			X	X	X	60 Days

Submit submittal data for all equipment, materials, test procedures, and routine maintenance procedures required for these items within sixty (60) calendar days after the Notice To Proceed and prior to any installation, unless noted otherwise in the Contract Documents.

Submit to the Engineer for approval, six (6) copies of the manufacturer's descriptive literature (Catalog Cuts), Technical data, operational documentation, service and maintenance documentation and all other materials required within these specifications.

Provide submittal data that is neat, legible, and orderly. Neatly organize each package of submittal data and separate by hardware item. Use the "Materials Certification Package Index and Transmittal Form", contained in Section 105.02 of the Special Provisions, for each pay item to document and list all material and components that are included in the submittal package. Any submittal data submitted without the Index/Transmittal form or that is incomplete will be rejected.

A. CCTV System, Type B; CCTV System, Type B, Retrofit Assembly; CCTV System, Type B, Retrofit Assembly (Furnish Only)

1. Camera System Assembly

Submit complete physical, performance, and operational materials submittal data for the camera system assembly and all associated components.

2. Camera System Assembly Mount

Submit complete physical, performance, and operational materials submittal data for the camera system assembly mount and all associated components and hardware.

3. Cabinet Interface Assembly

Submit complete physical, performance, and operational materials submittal data for the cabinet interface assembly and all associated components and hardware. Submit complete documentation for the CCTV system manufacturer's Embedded Protocol as implemented between the camera system assembly and the user control interface, and submit the setup and operations procedure for changeover between the NaviGator Standard CCTV Control Protocol and the CCTV system manufacturer's Embedded Protocol and vice versa. Submit the CCTV Embedded Protocol and control software application on CD-ROM with printed user documentation.

4. Cabling and Connectors

Submit complete physical, performance and operational materials submittal data for all cables, wire and connectors required for a complete and operational CCTV system. Submit cables and connectors as specified here and as recommended by the CCTV system manufacturer. Submit all CCTV system wiring diagrams and documentation as is required for as-built drawings in Subsection 936.3.05.B. Submit cabinet layout diagrams of all CCTV equipment. Submit CCTV manufacturer recommendations for all wiring and cabling, including but not limited to surge suppression and grounding/bonding. Submit CCTV manufacturer recommendations for the longest recommended cable distance between the Camera System Assembly and the CCTV interface equipment in the equipment cabinet; this distance shall be stipulated in consideration of all of the

associated components and incidental materials, including but not limited to the system electronics design, cable materials, surge suppression, and power supply.

5. Submittal Review Demonstration Test Set

Submit demonstration test set(s) for Department evaluation after the Engineer approves the submittal materials for the equipment and materials listed below. The demonstration test sets shall be connected to and operated through the NaviGator system by the Engineer. Deliver the test set to the Department at the location specified by the Engineer. Request a delivery and test time a minimum of 30 days in advance. Provide demonstration test sets of the materials, types and quantities as shown below:

- CCTV System, Type B (quantity 2)
- CCTV System, Type B, Retrofit Assembly (quantity 2)

A demonstration test set shall include all materials, components, assemblies, control software and documentation of a CCTV system, Type B, (and/or Retrofit Assembly) and shall be a complete, fully functional CCTV system. The camera system assembly and the camera system assembly mount shall be attached to a desktop stand that securely holds the camera system assembly while the camera is being operated. The cabinet interface assembly may be mounted to the desktop stand or to separate panel. Cables C1, C2, C3, C4, C5, and C6 shall be connectorized and terminated as required in these Special Provisions. Provide TB18 and SS15. Provide a NEMA 5-15 cord that provides power to the cabinet interface assembly and communications equipment. Provide a terminal block or strip for connection of the RS232 communications signal to the communications equipment (e.g., video encoder serial port); label each terminal position for the conductor function. Provide a video decoder, a minimum 10 ft (3 m) coaxial video cable and a minimum 13 in color video monitor for viewing the video output. Serial (PTZ) communications to the CCTV System shall be provided through the serial port on the video encoder.

If the contract shows CCTV Systems to be installed in conjunction with video encoders/decoders and field switches, provide demonstration test sets in accordance with Section 939 for video encoders, video decoders, and field switches simultaneously with the CCTV System demonstration test sets.

Review of the demonstration test set submittal shall be conducted in two parts. The first part of the review shall be performed by the Contractor in the presence of the Engineer and shall include the setup and configuration of the demonstration test set on the NaviGator system. The first part of the review shall be conducted during normal Department weekday business hours and shall be conducted for the period of time necessary to the satisfaction of the Engineer. The second part of the review shall be a 60-day period during which the Engineer shall operate and evaluate the demonstration test set with the NaviGator system. The second part of the review shall commence only upon the Engineer's approval of the first part of the review. Retrieve the demonstration test set upon completion of the second part of the review as notified by the Engineer.

For the first part of the demonstration test set review, the Contractor shall furnish and operate a serial data protocol analyzer to monitor and record the bi-directional RS232 communications session between the NaviGator session and the CCTV system. The protocol analyzer shall record all communications messages and shall time-stamp and record each byte of communications. Time-stamp resolution shall be no coarser than 0.10 millisecond. Provide recordings of all communications in the form of an MS-DOS-formatted ASCII text file. The protocol analyzer shall not be provided for the second part of the demonstration test set review, and the Contractor shall remove it at the end of the first part of the review.

B. Acceptance Testing

Submit acceptance test procedures and a desired acceptance test schedule.

C. Warranties and Guarantees

Submit materials submittal data providing complete example documentation on all manufacturers' warranties or guarantees on all CCTV system equipment and hardware components furnished, as required in Subsection 936.3.07.

D. Training

Prior to training, submit resume and references of instructor(s). Obtain approval from the Engineer that the instructor is qualified in his/her respective field. Submit the Training Plan within 120 days of the notice to proceed. Include in the training plan an outline of the training course. Obtain approval of the Training Plan from the Engineer. The Training Plan shall explain in detail the contents of the course and the time schedule of when the training shall be given. Coordinate actual training with installation schedules as approved by the Engineer.

936.2 Materials

936.2.01 CCTV System, Type B

Ensure that the individual components and assemblies of the CCTV System, Type B, conform to the requirements specified in the following sections. Ensure that all equipment, materials, components and assemblies of the CCTV System Type B conform to the CCTV manufacturer's requirements and recommendations.

A. Camera System Assembly

Follow these minimum requirements for a dome-enclosed camera system assembly including the camera, lens, pan/tilt drive, and control electronics.

Provide a downward-looking circular dome-shaped enclosure assembly. The enclosure shall have a maximum diameter of 14 in (356 mm) at its widest point and a maximum height of 22 in (559 mm) from the top of the housing assembly to the bottom point of the dome. The upper housing shall be constructed of a non-metallic UV-stabilized material of a light tan, gray, or white color, or constructed of an aluminum material with a heat-cured paint coating of an equivalent color. The lower housing shall be constructed of a UV-stabilized optically-correct acrylic material. The maximum weight of the complete and fully functional camera system assembly, including the camera, lens, pan/tilt drive, control electronics, environmental control components, housing assembly, and hub adapter shall be 25 lbs (11.4 kg).

Use an enclosure assembly that secures to the mounting bracket arm with a 1-1/2 in (37.5 mm) threaded pipe nipple. Hub adapters for the threaded pipe nipple on either the enclosure or the mounting arm, or both, are permitted.

All fastening and mounting hardware on or within the enclosure assembly shall be stainless steel.

Use a pressurized enclosure assembly that uses extra dry grade nitrogen. Provide a pressure relief valve and a Schrader valve for filling and evacuating the enclosure. An additional pressure relief screw is allowed. All mounting and wiring connections shall be pressure-tight. Ensure an operating pressure range of 3-7 psi.

Electrical power for the complete camera system assembly shall be per the manufacturer's recommendations and between 12V to 120V DC or single-phase AC utilizing a two-wire (not counting ground) supply from the cabinet interface assembly in the equipment cabinet. Do not use a dual-voltage power supply. Maximum electrical load with all subsystems operational, including the heater, shall be no more than 130 VA.

Use an enclosure assembly with a heater and a circulating blower fan for environmental (temperature and defogging) control. Maximum electrical load for the heater shall be no more than 80 VA.

Use a camera unit with an integrated camera sensor and zoom lens assembly and an analog NTSC-compliant composite video output with a signal-to-noise ratio of 45dB or greater. The camera shall use an 1/4-inch interline transfer CCD image sensor, with a minimum of 768 horizontal by 492 vertical active picture elements. All elements shall remain operational. The camera shall have a minimum resolution of 460 horizontal TV lines by 350 vertical TV lines. The camera shall include on/off selectable automatic gain control and manual/automatic selectable white balance. The camera shall include an electronic shutter mode with user-selectable speeds of a minimum range from 1/60 second to 1/10,000 second. The camera unit shall provide an on/off selectable day/night function where the image sensing and output automatically switch between color and black-and-white imaging; fixed color or black-and-white imaging shall be user-controllable. The camera sensitivity shall be no less than 3.0 lux in color mode (1/60 second) and 0.5 lux in black-and-white mode (1/60 second, IR cut removed).

Provide a camera unit with an integrated zoom lens of a minimum of 22X optical zoom and a minimum of 4X digital zoom. The camera shall not employ any digital zoom functionality unless the lens is at the full limit of optical zoom and the zoom command continues to be applied, in which case the camera unit shall automatically switch from optical to digital zoom. The optical focal length shall be approximately 4 mm to 80 mm. The camera unit shall include on/off selectable automatic focus and manual/automatic selectable iris control.

Use a pan/tilt drive for the camera unit that is fully-contained within the enclosure assembly. The drive shall be capable of 360 degree panning and at least 0 degree horizontal to 90 degree vertical looking downward tilting. The camera unit and pan/tilt drive shall provide automatic 180-degree image output flip at the bottom of the tilt travel. The camera unit and pan/tilt drive shall provide a minimum of eight privacy blackout zones, each zone being individually programmable to be on/off by the user. The panning speed, when a pan-left or pan-right command is applied by the user, shall be between 10 and

18 degrees per second. The tilting speed, when a tilt-up or tilt-down command is applied by the user, shall be between 4 and 10 degrees per second.

Provide a system control interface to the camera system assembly that physically and logically supplies the user commands to and monitoring from the camera system assembly, including but not limited to pan, tilt, zoom, focus, position reporting, and configuration. The system control interface shall physically connect the camera system assembly to the cabinet interface assembly through cables C1 and C3 as specified below. Do not use a system control interface through cable C2. Provide a system control interface as RS422 or RS485 serial data communications of any messaging format that is in compliance with all of the physical and operational requirements specified for a CCTV System, Type B. Provide the capability to set the communications address used by the Standard Protocol (subsection 936.2.01.C) through the system control interface or through the user control interface in the cabinet; do not require the opening/disassembly of the camera system enclosure to set the communications address. Store all user configurable settings in non-volatile memory that is retained indefinitely upon loss of power.

Provide integral surge suppression features in the camera system assembly, within the dome enclosure, for all ungrounded conductors of the power, communications, and video signal lines. This surge suppression is secondary to the surge suppression in the equipment cabinet. Surge suppression technology shall as a minimum be low capacitance implementations of components such as gas tube, metal oxide varistor (MOV), isolation transformer, silicon avalanche/zener/transorb diode, positive temperature coefficient (PTC) resettable fuse, opto-isolator, or equivalent, or a hybrid of these components.

B. Camera System Assembly Mount

Provide a camera system assembly mount that includes a mounting bracket arm, camera enclosure mount and disconnect, mounting straps, and incidental fastening hardware. All fastening and mounting hardware shall be stainless steel.

The mounting bracket arm shall be suitable for pole-mounted applications using mounting straps or bolts. The bracket shall be fabricated to exactly mate with the camera enclosure mount/disconnect/pipe nipple and any needed pole-mount adapter with no drilling or welding required. The bracket shall be fabricated from aluminum alloy with an exterior polyurethane coating, stainless steel, or mild steel with a heat-cured paint coating. All bracket coatings shall be beige, tan, gray or off-white in color and corrosion resistant in accordance with MIL-STD-810F(3) Method 509 Procedure 1 for exterior salt atmospheres.

Use a mounting bracket arm that locates the vertical centerline of the camera enclosure from 14 in (356 mm) to 24 in (610 mm) from the exterior surface of the support pole. The mounting bracket arm shall provide for cable entrance through the base of the bracket directly from the support pole and from the exterior through a raintight opening on the underside of the bracket and adjacent to the support pole. Provide non-metallic cable protection grommets for both cable entrances.

Use a mounting bracket arm that fully encloses the cable connectors J1 and J2 and the manufacturer's connector on the camera enclosure for cable C3. Provide a mounting bracket arm with a minimum interior cross-sectional area of 5 square in (32 square cm.) Provide a raintight access opening (minimum 2 in by 12 in (5 cm by 30 cm) to cable connectors J1 and J2 on the underside of the bracket with captive attachment hardware and access cover retaining lanyard. Provide a raintight access to the camera enclosure connector for cable C3 with captive attachment hardware and access cover retaining lanyard.

Include a camera enclosure mount and disconnect on the mounting bracket arm that secures to the camera enclosure with a 1-1/2 in (37.5 mm) threaded pipe nipple. Hub adapters for the threaded pipe nipple on either the enclosure or the mounting arm, or both, are permitted. When installed and fastened, the completed mounting mechanism assembly shall rigidly connect the camera enclosure to the mounting bracket arm with no movement relative between the enclosure and the arm. Provide a disconnect means for dismounting and remounting the camera enclosure from the mounting bracket arm with the use of threaded fasteners or locking pinned/slotted/keyed attachment mechanism and without the need to unthread the 1-1/2 in (37.5 mm) pipe nipple. The disconnecting means shall be compatible with the camera system manufacturer cable C3 and connector.

Unless otherwise shown in the Plans, mount the bracket arm to the support pole using a minimum of two 1/2 in (12.5 mm) or greater stainless steel mounting straps.

C. Cabinet Interface Assembly

Use a cabinet interface assembly that provides electrical service for the camera system assembly and provides the user control interface connection to the NaviGator system and/or user personnel. Install the cabinet interface assembly in the

equipment cabinet. All fastening and mounting hardware shall be stainless steel. The cabinet interface panel assembly includes the following:

- CCTV Interface Enclosure
- Camera System Assembly Power Supply with surge suppression
- terminal blocks and video cable surge suppression for camera system assembly cabling
- user control interface to the NaviGAator system and/or user personnel with surge suppression

Use the CCTV Interface Enclosure to hold the Camera System Assembly Power Supply and the user control interface unit for the camera electrical service and system control interface data path as shown in detail drawing 936.1a and 936.1b. The CCTV Interface Enclosure shall be rack mountable on a standard 19" rack and located in cabinet rack as shown in detail drawing 936.2a and 936.2b. The CCTV Interface Enclosure height shall not exceed 3 Rack Units, and it shall not exceed a depth of 15 inches. The CCTV Interface Enclosure shall provide the connector ports as defined below; unless otherwise specified, all connector ports shall be pluggable polarity-keyed terminal blocks with touch-safe design (Phoenix Contact Combicon blocks or approved equivalent) and rated for the voltage and current of the application. All connector ports shall be labeled as specified here and shall be located on the rear of the CCTV Interface Enclosure. The CCTV Interface Enclosure shall be labeled with the manufacturer model and part number of the camera system assembly with which the enclosure is supplied.

Provide a Camera System Assembly Power Supply in the CCTV Interface Enclosure that supports all electrical service needs for all components and subsystems of the camera system assembly and CCTV Interface Enclosure. Connect the line and neutral inputs of the CCTV Interface Enclosure power connector port labeled "CP Power" to the equipment cabinet's 120VAC electrical supply on terminal block TB2 as shown in the CCTV system detail drawings, and use standard conductor insulation colors for 120VAC electrical service (black, white, and green). Provide a copper or copper alloy grounding lug on the CCTV Interface Enclosure and bond all internal components to the grounding lug; connect the grounding lug to the cabinet ground busbar. Connect the power supply output of the CCTV Interface Enclosure, labeled "CP1", to the camera system assembly directly to the terminals of TB18, connecting to cable C1. Use only stranded copper wiring, with a minimum #12 AWG for the line and neutral conductors of the 120VAC circuit to TB2, and a minimum wire size recommended by the CCTV system manufacturer for the power supply circuit to TB18 but not less than #18 AWG. Ground the input and output sections of the power supply in accordance with the CCTV system manufacturer's recommendations. The power supply shall not have any fusing for any circuit except for socket/holder mounted fusing. The power supply shall include a switch located on the front of the CCTV Interface Enclosure to disconnect power from the camera system assembly. The power supply and user control interface unit shall be sized so that they can fit inside the CCTV Interface Enclosure.

Provide a transient voltage surge suppressor for the power conductors to the camera system assembly. Use a surge suppressor that is independent of and external to the Camera System Assembly Power Supply. Use a surge suppressor rated for the voltage, current, and polarity of the Camera System Assembly with MOV/diode/thermal fusing hybrid technology and a -40C to +75C operating temperature.

Provide terminal block TB18 for the termination of cable C1 from the camera system assembly and the termination of wiring from the power supply and the user control interface unit. Mount TB18 on the equipment cabinet side panel as shown in the CCTV system detail drawings, not in the CCTV Interface Enclosure. Use a 14-position dual-screen barrier type terminal block with 7/16 in (11.11 mm) spacing using nickel-plated brass 6-32 phillslot screw (Cinch 141 or approved equivalent) and quick-clamp type wire terminals (Cinch QC-1 or approved equivalent). Use a terminal block with voltage and current ratings greater than the voltage and current ratings of the wires, which are terminated on the block. Provide an EMI/RFI shield over the terminal block if recommended by the CCTV system manufacturer. Do not use compression-type, tubular clamp, or spade lug terminals. Provide a connector port on the CCTV Interface Enclosure for connection to TB18; label this port "CP2."

Provide surge suppressor SS15 for the protection and termination of the coaxial video cables C2 and C4. Mount SS15 on the equipment cabinet side panel as shown in the CCTV system detail drawings, not in the CCTV Interface Enclosure. Use a shielded gas-tube and diode hybrid technology or equivalent with 6-volt line-to-ground clamping, 20kA peak surge current, -40C to +75C operating temperature, and BNC coaxial connectors. The maximum dimensions of SS15 are 4 in L x 2 in H x 1.5 in W (102 mm L x 51 mm H x 38 mm W.) Use a minimum #16 AWG stranded copper insulated green wire to ground SS15 directly to the cabinet ground bussbar.

Provide a user control interface on the CCTV Interface Enclosure to provide for control and monitoring communications between the camera system assembly and the NaviGAator system user. The user control interface port shall be a DB9

connector labeled "CP4" that matches the RS-232 cable provided with the CCTV Embedded Protocol control software required below. The user control interface unit shall fully support control and monitoring communications from the NaviGator Standard CCTV Control Protocol and from the CCTV system manufacturer's own embedded protocol; simultaneous operation of these two protocols is not required. The user control interface unit shall be a protocol switching or translation, port-sharing or port-coupling, or similar device that controls and monitors the camera system assembly through its system control interface.

The NaviGator Standard CCTV Control Protocol (hereinafter called the "CCTV Standard Protocol") is specified below and shall connect to the user control interface unit through an RS-232 serial data interface directly from the NaviGator system. Connect the user control interface inside the CCTV Interface Enclosure to the CCTV Standard Protocol with cable C5 through the connector port labeled "CP3". Provide the CCTV system manufacturer's proprietary embedded protocol (hereinafter called the "CCTV Embedded Protocol") as a Microsoft Windows-based PC software application with user interface. Provide the CCTV Embedded Protocol and control software application on CD-ROM with printed user documentation. The CCTV Embedded Protocol control software shall be capable of fully operating the camera system assembly and user control interface unit, including but not limited to control, monitoring, and configuration. Operate the control software through a cable connection between the user control interface unit and an RS-232 serial data interface on a Windows-based PC. Provide the control software with a properly configured RS-232 cable (minimum length 6 ft) with a female DB-9 connector on the cable end attached to the computer and a pre-configured connector or termination on the end attached to the user control interface unit. Provide the control software with an unrestricted, non-cancelable user license for the Department's use with any NaviGator equipment at any location. Furnish three copies each of the software, license, appropriate RS-232 cable, and user documentation per project.

Changeover between CCTV Standard Protocol and CCTV Embedded Protocol control and monitoring communications with the camera system assembly shall occur only through the user control interface unit. There shall be no requirement to physically access the camera system assembly or to reconfigure any wiring between the cabinet interface assembly and the camera system assembly. Use of different interface ports, or use of the same port, on the user control interface unit for the two protocols is permitted provided that the CCTV Embedded Protocol port is connectorized. Configuration changes to the user control interface unit to switch operation between the two protocols is not permitted, including but not limited to dipswitch or jumper settings.

Connect the user control interface unit, using cable C6, to TB18 for connection through C1 to the camera system assembly. Use a single one, two or three pair multi-pair cable of stranded copper wiring, minimum #18 AWG, twisted and/or shielded as recommended by the CCTV system manufacturer, and label this cable C6. Ground or bond any C6 cable or pair shielding and any unused conductors in accordance with the CCTV system manufacturer's recommendations. Do not connect unused conductors of C1 to the user control interface unit unless recommended by the CCTV system manufacturer. Connect C6 directly to the terminating port on the user control interface unit; do not use any port adapters, gender changers, couplers, or similar components. Provide an automatically-resetting surge suppressor for each connected ungrounded conductor between the user control interface unit and TB18. Use a surge suppressor with low capacitance gas-tube and diode hybrid technology or equivalent with a 10kA peak surge current (8x20 waveform) and -40C to +75C operating temperature.

Connect the user control interface unit to the Video Encoder port with cable C5. Use a single multi-conductor or multi-pair cable with minimum stranded copper #18 AWG, with twisted pairs and/or shielded/bonded as recommended by the CCTV system manufacturer, and label this cable C5. Ground or bond any C5 cable or pair shielding and any unused conductors in accordance with the CCTV system manufacturer's recommendations. Cable C5 shall be pre-connectorized on one or both ends as required for the user control interface and the Video Encoder port configurations and as required by the CCTV system manufacturer. Connect C5 directly to the terminating ports on either end; do not use any port adapters, gender changers, couplers, or similar components.

D. CCTV Standard Protocol

1. General

Use the NaviGator Standard CCTV Control Protocol (hereinafter called the "CCTV standard protocol" or "standard protocol") for CCTV system control communications between the user control interface unit and the NaviGator central system. Implement the standard protocol as specified in this subsection for all CCTV equipment installed on this project. The CCTV standard protocol governs all control communications between the NaviGator central system (hereinafter called the "host") and the CCTV system specified in this Subsection 936.2.01 (hereinafter called the "remote"). Do not implement any other control communications except as required and specified in this Subsection 936.2.01.C.

2. Interface

The remote shall communicate using the CCTV standard protocol over an RS-232 serial interface. Data is transmitted using 1 start bit, 8 data bits, and 1 stop bit (no parity) at a baud rate of 9600.

Each remote shall be identified by a unique integer address between 1 and 233. This address is set during installation and shall not be altered using the standard protocol. The address is included in messages to identify the intended recipient of commands from the host and responses from the remote.

3. Message Sequence

All communication between the host and the remote is initiated by the host. The remote shall not transmit except in response to a properly formatted message from the host addressed to the remote's assigned address. The remote shall respond to such messages with an ACK (a single ASCII character 0x06) within 500 milliseconds ("ACK timeout"). The remote shall be ready to receive and process another command in as little as 150 milliseconds after the ACK is transmitted ("Inter-command spacing"). Figure 1 below depicts this sequence.

Figure 1 - Basic Message Sequence

Some messages from the host require a subsequent response message from the remote. In this case, the remote's ACK shall be followed immediately by a response message. When the host receives the properly formatted response, it will transmit an ACK back to the remote. This sequence is depicted below in Figure 2. The timing constraints presented above apply. Additionally, the host will wait a maximum of 500 milliseconds for each byte in the response message ("Inter-byte timeout").

Figure 2 - Response Message Sequence

4. Message Format

Command and response messages shall be formatted as shown below in Table 1.

Table 1 - Message Format

Size	Data	Description
1 byte	0xF8	Message header
1 byte	Address	Controller address (0x01 to 0xDF)
2+ bytes	Message Data	(see Command and Response Message sections below)
1 byte	Checksum	0x80 to 0x8F (see below)

Messages start with a single-byte header followed by a single-byte address. Two or more message data bytes follow the address. The message is terminated with a single-byte checksum.

Checksum Calculations

The message checksum byte is defined as the least significant nibble of the exclusive-or of all previous bytes in the message (excluding the 0xF8 header) added to 0x80. The resulting byte will be between 0x80 and 0x8F inclusive.

Checksum Example:

- The bytes of a “Pan Left” command addressed to controller 1 would be:
0xF8 0x01 0x50 0x4C 0x??
- The bitwise exclusive-or of the bytes between the 0xF8 header and the checksum comes out to 0x1D.
 $0x01 \wedge 0x50 \wedge 0x4C = 0x1D$
- Adding the least significant nibble to 0x80, we get 0x8D for the checksum byte.
 $0x80 | (0x0F \& 0x1D) = 0x8D$
- The resulting 5-byte command would be
0xF8 0x01 0x50 0x4C 0x8D

5. Command Messages

The tables below present the message data contained within command messages sent by the host to the remote. In most cases (exceptions will be noted), the “Data” column contains the ASCII characters of the message data to be sent. For example, the Pan Left command data is “PL”, an ASCII ‘P’ (0x50) followed by an ASCII ‘L’ (0x4C).

An “ACK” in the “Response” column indicates no response message is expected from the remote beyond the ACK itself as shown above in Figure 1. An “ACK + * Response” indicates the ACK from the remote is to be followed by the specified response message as shown above in Figure 2.

Table 2 - Momentary Commands

Command	Data	Response
Pan Left	“PL”	ACK
Pan Right	“PR”	ACK
Pan Stop	“PS”	ACK
Tilt Up	“TU”	ACK
Tilt Down	“TD”	ACK
Tilt Stop	“TS”	ACK

Zoom In	"ZI"	ACK
Zoom Out	"ZO"	ACK
Zoom Stop	"ZS"	ACK
Focus Near	"FN"	ACK
Focus Far	"FF"	ACK
Focus Stop	"FS"	ACK
Iris Open	"IO"	ACK
Iris Close	"IC"	ACK
Iris Stop	"IS"	ACK

Table 3 - Position Commands

Command	Data	Response
Pan/Tilt Position Request	"P?"	ACK + Pan/Tilt Response
Pan/Tilt Goto Command	"pA2A1A0E2E1E0" (see Position Encoding below)	ACK
Zoom/Focus Position Request	"V?"	ACK + Zoom/Focus Response
Zoom/Focus Goto Command	"vZ2Z1Z0F2F1F0" (see Position Encoding below)	ACK

Table 4 - Latch Commands

Command	Data	Response
Manual Iris Toggle	"LM"	ACK
Camera Power Toggle	"LP"	ACK
Lens Speed Toggle	"LL"	ACK
Latch Status Request	"L?"	ACK + Latch Response

Table 5 – Preset Commands

Command	Data	Response
Goto Preset 0 – 9	"H0" – "H9"	ACK
Store Preset 0 – 9	"P0" – "P9"	ACK
Preset Status Request	"H?"	ACK + Preset Response

Position Encoding

The message data for the "Pan/Tilt Goto Command" above begins with an ASCII 'p' followed by the azimuth ($A_2A_1A_0$) and elevation ($E_2E_1E_0$) positions. The positions are 12-bit values encoded four-bits each in to the least significant nibbles of the

three bytes whose most significant nibbles are always 0x30. The subscript-2 indicates the byte containing the most significant bytes of the position and subscript-0 indicates the least significant.

Position Encoding Example: Encoding an azimuth position value of decimal 2748 or 0xABC, we break it up into three nibbles and add 0x30 to each so $A_2 = 0x3A$, $A_1 = 0x3B$, and $A_0 = 0x3C$.

The same encoding scheme is used for the zoom and focus positions in the "Zoom/Focus Goto Command".

6. Response Messages

The table below presents the message data contained within response messages sent by the remote to the host.

Table 6 – Response Messages

Message	Data	Comment
Pan/Tilt Position Response	"PA ₂ A ₁ A ₀ E ₂ E ₁ E ₀ " (see Position Encoding above)	using the same data encoding as Pan/Tilt Goto Command described earlier. (note: while the command uses a lower-case 'p', the response uses an upper-case 'P')
Zoom/Focus Position Response	"VZ ₂ Z ₁ Z ₀ F ₂ F ₁ F ₀ " (see Position Encoding above)	using the same data encoding as Zoom/Focus Goto Command described earlier. (note: while the command uses a lower-case 'v', the response uses an upper-case 'V')
Latch Response	"LD ₁ AD ₀ " $D_1 = 0x30$ to $0x38$ $D_0 = 0x30$ to $0x37$	The bits of D_1 , the second byte in the data, indicate: 0: Iris Auto(0) or Manual(1) 1: Camera Power Off(0) or On(1) 2: Lens Speed Slow(0) or Fast(1) 3: Comm. Error No(0) or Yes(1) 4: (always 1) 5: (always 1) 6: (always 0) 7: (always 0) The bits of D_0 , the fourth byte in the data, indicate: 0: Aux-1 Off(0) or On(1) 1: Aux-1 Off(0) or On(1) 2: Aux-1 Off(0) or On(1) 3: (always 0) 4: (always 1) 5: (always 1) 6: (always 0) 7: (always 0)
Preset Response	"H D ₀ "	D_0 is a single ASCII character indicating: '0'-'9': at the indicated preset 'A': active, going to a preset

		'I':inactive, not at a preset
		'E':error, unable to get to preset

While the remote is going to a position as a result of a “Pan/Tilt Goto”, “Zoom/Focus Goto”, or “Preset Goto” command, “Preset Responses” will return ‘A’ in the D0 byte. If the remote is unable to get to the position in the “Goto” command (i.e. the pan/tilt assembly reaches the mechanical stops), the “Latch Response” will return ‘E’ in the D0 byte.

E. Cabling and Connectors

Provide cabling and connectors between the camera system assembly and the cabinet interface assembly as shown in the CCTV system detail drawings and in the Plans.

Provide coaxial video signal cables C2 and C4, with labels attached at both ends of each cable. Video signal cable C2 shall be double-shielded with tinned copper braid, #20 AWG solid copper center conductor, and polyethylene outer jacket approved for outdoor use (Belden 8281 or approved equivalent.) Video signal cable C4 shall be high-flexibility double-shielded with tinned copper braid, #22 AWG stranded copper center conductor, and PVC outer jacket (Belden 8281F or approved equivalent.) Use BNC connectors with gold-plated center pins on the video signal cables; use only connectors recommended by the cable manufacturer.

Provide control cable C1 with labels attached at both ends of the cable. Control cable C1 shall be a UL-listed six twisted-pair power limited tray cable with #18 AWG 19-strand tinned copper conductors with individual foil or braid shield on each pair and UV-resistant PVC or polyethylene outer jacket rated for 300 V, -20C to 105C operating range and suitable for aerial, outdoor, and underground conduit use. Terminate cable C1 in the equipment cabinet on TB18 as shown in the CCTV system detail drawings and as recommended by the CCTV system manufacturer. Ground or bond any pair shielding and any unused conductors in accordance with the CCTV system manufacturer’s recommendations.

Provide camera system assembly connector cable C3 to connect cables C1 and C2, through connectors J1 and J2 respectively, with the camera system assembly connector as provided by the CCTV system manufacturer. Cable C3 shall be manufactured and configured to mate with connectors J1 and J2 in accordance with the conductor assignments shown in the CCTV system detail drawings and the CCTV system manufacturer’s recommendations. Use stranded copper conductors, or a solid copper conductor for a coaxial cable, with minimum 75 degree C individual conductor and outer jacket insulation ratings on all materials. Cable C3 shall be configured with the minimum length necessary for connection within the mounting bracket arm to J1, J2 and the camera system assembly connector, while providing sufficient slack for a technician to disconnect and reconnect the cable at the camera system assembly connector. Cable C3 shall mate to the camera system assembly connector with a positive locking mechanism to prevent vibration from loosening the connection. The camera system assembly connector shall use gold-plated pins and sockets. Connector J1 on cable C3 shall be configured with male conductor pins. Connector J2 on cable C3 shall be a coaxial cable BNC connector as specified for cables C2 and C4 above. All connectors on cable C3 shall be strain-relieved. Label the cable as C3 and with the camera system manufacturer’s name and model number.

Terminate the aerial end of cable C1 with connector J1, which shall connect to mating connector J1 on C3. For J1 use a strain-relieved CPC 17-14 free-hanging plug and receptacle connector set (AMP 206043 / 206044 or compatible and approved equivalent) with gold-over-nickel spring-detent two-piece pins and sockets, with female conductor sockets terminated on cable C1. Do not use one-piece “formed” pins and sockets.

Terminate the aerial end of cable C2 as connector J2 with a BNC connector as specified for cables C2 and C4 above. Connect cable C2 to cable C3 through a BNC coupler with gold-plated center socket.

At the CCTV system manufacturer’s option and recommendation, submit for approval a single-jacketed composite cable that contains conductors and sub-cables with the equivalent function of cables C1 and C2. The composite cable shall have an UV-resistant PVC or polyethylene outer jacket rated for 300 V, -20C to 105C operating range and suitable for aerial, outdoor, and underground conduit use. The composite cable shall contain as a minimum: two (2) shielded-twisted pairs of #22AWG stranded conductors with drain wires; three (3) #16AWG stranded THHN-THWN conductors; and one (1) coaxial sub-cable exactly equivalent to cable C1 specified herein. Label the composite cable as C1/C2. Terminate cable C1/C2 in the equipment cabinet and in the mounting bracket arm by splitting out the separate conductors and sub-cables from the outer jacket; strain-relief with tie-wraps at the outer jacket opening. Terminate separated conductors in cable C1/C2 exactly as required for individual cables C1 and C2 at connectors J1 and J2, on TB18, and at SS15, following the exact pin-outs as shown in the CCTV system detail drawings. Ground or bond any pair shielding and any unused conductors in accordance with the CCTV system manufacturer’s recommendations.

936.2.02 CCTV System, Type B, Retrofit Assembly

Furnish a complete CCTV System, Type B, Retrofit Assembly to be installed at existing CCTV sites with existing support poles, equipment cabinets, power service, and communications systems. Ensure that the individual components and assemblies of the CCTV System, Type B, conform to all requirements specified in Subsection 936.2.01. The retrofit assembly includes all equipment and materials specified in Subsection 936.2.01 including but not limited to the camera system assembly, mount, cabinet interface assembly, communications and protocols, and cabling and connectors. Provide all new materials, including all surge suppressors and wiring to/from existing cabinet equipment such as C4, C5, SS15 and mounting plate, TB18 and mounting plate, 120VAC wiring to the cabinet interface assembly, and ground wiring to the cabinet interface assembly.

Determine and furnish the necessary CCTV System, Type B, cable lengths for all cables at each site shown in the Plans, including but not limited to cables C1 and C2 in the pole and all cables and wiring within the cabinet, as required by the equipment mounting locations. Determine and furnish the required C5 connector at the communications device end with proper pinout. Use the exact mating connector for the communications device port; do not use any port adapters, gender changers, couplers, or similar components.

936.2.03 CCTV System, Type B, Retrofit Assembly (Furnish Only)

Furnish a complete CCTV System, Type B, Retrofit Assembly (Furnish Only) to be delivered to the Department. Ensure that the individual components and assemblies of the CCTV System, Type B, conform to all requirements specified in Subsection 936.2.01. The retrofit assembly (furnish only) includes all equipment and materials specified in Subsection 936.2.01 including but not limited to the camera system assembly, mount, cabinet interface assembly, communications and protocols, and cabling and connectors. Provide all new materials, including all surge suppressors and wiring to/from existing cabinet equipment such as C4, C5, SS15 and mounting plate, TB18 and mounting plate, 120VAC wiring to the cabinet interface assembly, and ground wiring to the cabinet interface assembly. Ensure compliance with all fabrication and assembling requirements of Subsection 936.3.05, including but not limited to fastening hardware, wiring and mounting labeling, and wiring and cabling dressing, bundling, and strain relief.

Unless otherwise shown in the Plans, provide a cable length of 85 ft (26m) for C1 and fully terminate one end with connector J1. Provide a cable length of 85 ft (26m) for C2 and fully terminate both ends with male BNC connectors. Provide a cable length of 4 ft (1.2m) for cables C4, C5, C6, camera system power from TB18 to the camera interface assembly, 120VAC wiring to the cabinet interface assembly, and ground wiring to the cabinet interface assembly. Terminate both ends of cable C4 with male BNC connectors. Strip bare and tin the communications device end of cable C5. All other cable ends shall be terminated with the appropriate mating connector of the cabinet interface assembly; conductor ends intended for terminal blocks shall be stripped bare and tinned.

936.2.04 Delivery, Storage, and Handling

A. CCTV System, Type B, Retrofit Assembly (Furnish Only)

Provide all materials in protective packaging suitable for shipping and storage. Label all boxes with contents, including manufacturer name, model, serial numbers, and project number. Package each CCTV system in individual boxes as units of one complete CCTV System, Type B, Retrofit Assembly; multiple boxes for one assembly is acceptable, but multiple assemblies in the same box is not. Deliver assemblies to the Department at the location specified by the Engineer. Deliver at one time the full quantity of complete assemblies as shown in the Plans; multiple deliveries are not permitted.

936.3 Construction Requirements

Ensure that all construction for the equipment, materials, components and assemblies of the CCTV System Type B conform to the CCTV manufacturer's requirements and recommendations.

936.3.01 Personnel

Not applicable

936.3.02 Equipment

Not applicable

936.3.03 Preparation

Not applicable

936.3.04 Fabrication

Not applicable

936.3.05 Construction

A. General Requirements

Request that the Department establish the utility service(s) required for a CCTV installation as described in Section 939.

B. CCTV System, Type B (all)

1. Installation Requirements

Mount the camera system assembly and the mounting bracket arm at the cardinal direction and height as shown in the Plans.

Install cables C1 and C2 between the camera system assembly and the equipment cabinet inside new hollow metal or concrete support poles unless otherwise specified. Where devices are installed on existing wood poles, install cabling on the wood poles in rigid metal conduit risers of minimum 2 in (50.8 mm) diameter. Use weather heads on all nipple and conduit openings. Neatly install and route cabling to minimize movement in the wind and chafing against the pole, device or bracket. Form a drip loop at the weather head and route cabling to prevent water entry into the weatherhead or mounting bracket arm. Install the mounting bracket arm no more than 8 in (204 mm) above the weatherhead, and install a drip loop that is no more than 6 in (152 mm) below the weatherhead at the loop's lowest point.

Install the cabinet interface assembly components in the equipment cabinet as shown in the CCTV system detail drawings. Neatly arrange and dress all wiring, firmly lace or bundle it, and mechanically secure the wiring without the use of adhesive fasteners. Route and secure all wiring and cabling to avoid sharp edges and to avoid conflicts with other equipment or cabling. Route all CCTV cables separate from any 120VAC power wiring or surge suppressor ground wiring. Neatly coil and dress between 3 ft (1 m) and 5 ft (1.5 m) of cables C1 and C2 in the bottom of the cabinet. Dress and route grounding wires separately from all other cabinet wiring and with the minimum length possible between the suppressor and the ground bussbar. Do not splice any cable, shield or conductor used for video, control, communications signaling, power supply, or grounding.

Fasten all components of the cabinet interface assembly to be mounted on the equipment cabinet side panel or on the CCTV Interface Enclosure with stainless steel hex-head or phillips-head machine screws. Install the screws into tapped and threaded holes in the panels. Fasten stud-mounted components to a mounting bracket providing complete access to the studs and mounting nuts. All fastener heads and nuts (when used) shall be fully accessible within the equipment cabinet, and any component shall be removable without requiring removal of other components, panels, or mounting rails. Do not use self-tapping or self-threading fasteners. Label TB18, each terminal position on TB18, and SS15 on the equipment cabinet side panel with silk-screened lettering on the panel.

For CCTV System, Type B, Retrofit Assembly, unless otherwise shown in the Plans, remove and dispose of all existing CCTV equipment including camera enclosures and mounting arms, pole-mount hardware, all cables from cabinet to camera, and all CCTV-specific wiring devices inside the cabinet including surge suppressors. Where shown in the Plans to salvage and return any existing CCTV equipment, remove and deliver the identified equipment to the location specified by the Engineer in the same condition as prior to the project. Repair or replace any equipment damaged by the Contractor's operations. Do not remove or disturb any pole equipment, hardware or wiring, or existing cabinet equipment and wiring including those materials for other devices, cabinet power service, and communications systems. Mount new CCTV equipment and materials in the existing cabinet in locations as close as possible to the same locations required in new cabinet installations.

2. CCTV System Configuration

Program and configure the CCTV system in accordance with the procedure below. Provide all required documentation in writing with all data recorded in the format of the NaviGator Standard CCTV Control Protocol. Perform the CCTV system configuration in accordance with the acceptance procedures in subsection 936.3.06. It should be noted that configuration requirements specified herein are independent of the video encoder. CCTV System Configuration is not required for CCTV System, Type B, Retrofit Assembly (Furnish Only).

Configure each CCTV system with the communications address specified by the Department, prior to any acceptance testing at a given CCTV system site. Configure the communications address as "001" unless otherwise shown in the Plans or directed by the Engineer.

GDOT's "ATMS Surveillance Camera Control Integration and Calibration Procedure" is as follows:

- Record the position status setting for the full pan left and pan right stops. The pan left and pan right stops are defined as the camera positions when the pole initially comes into view from either direction at maximum zoom.
- Record the position status setting and angle (degrees from horizon) for maximum tilt up and maximum tilt straight down (90 degrees down from horizontal).
- Record the position status settings for each end of maximum focus range.
- Record the position status settings for maximum zoom out and zoom in.
- Provide to the Department the following information from each field installation site:
 - Location (as shown in Plans)
 - Height of camera (ft) above travel lanes
 - Azimuth (compass heading in degrees at camera's right stop as defined above)
 - Azimuth (compass heading in degrees at camera's left stop as defined above)
 - Device ID as shown on the Plans (example: CAM001)
 - CCTV system communications address (example: 001)
 - IP address, port/socket of serial port on Encoder
 - Video switch input port (when connected)
 - Comments

3. As-Built Drawings

Furnish as-built CCTV system wiring diagrams, identified by location. Include all wiring, cabling, conductor function, connector type and connector pinouts. Included but not limited in the documentation requirements are cables C1, C3, C5, C6, the CCTV embedded protocol control software cable, and all connectors and terminations on the cables, the camera system assembly, TB18, the user control interface unit and power supply of the cabinet interface assembly, and the communications equipment. Place all documentation in a weatherproof sleeve and place in the cabinet drawer. As-built drawings are not required for CCTV System, Type B, Retrofit Assembly (Furnish Only).

936.3.06 Quality Acceptance

A. General

Acceptance testing of CCTV System, Type B, and CCTV System, Type B, Retrofit Assembly consists of three phases: 1) field installation testing; 2) CCTV system site testing; and 3) burn-in period. After the Engineer's granting of burn-in period

completion, obtain CCTV system acceptance. Acceptance testing of CCTV System, Type B, Retrofit Assembly (Furnish Only) consists of bench acceptance testing.

Perform acceptance testing for all equipment, hardware and work provided under this Contract, including each CCTV video surveillance field installation assembly and all associated communications hardware at a control center or communications hub. Perform all testing in the presence of the Engineer. Notify the Engineer of a desired acceptance test schedule no less than fourteen calendar days prior to beginning the testing except for testing using the NaviGator software and existing NaviGator control center and communications equipment. For acceptance testing using the NaviGator software and existing NaviGator control center and communications equipment, coordinate this testing with the Engineer no less than 30 days prior to the start of this testing.

Except as provided herein regarding the Department's NaviGator software, develop, provide all equipment for, and perform all acceptance testing for all CCTV system equipment, hardware and work. Develop detailed and thorough test procedures with full test plan descriptions, test and measurement equipment listings, and test results data sheets. As part of the submittal data requirements, submit these test plans to the Engineer for approval. The Engineer will notify the Contractor of the approval or disapproval of the test procedures; only test procedures approved by the Engineer can be used. Provide all necessary testing and measurement equipment. Have a complete copy of all materials and equipment submissions and all documentary items on hand at all acceptance testing sessions.

Make the acceptance testing plan a detailed and thorough procedure for both the field installation test and the CCTV system site test. Demonstrate that the CCTV system equipment, hardware and work meet all requirements of the Contract. These requirements include but are not limited to all design, construction, materials, equipment, assembly, documentation of manufacturer's certification of assembly and configuration, environmental, performance, communications, video and data communications signal strength and clarity, compatibility with the NaviGator software, and documentary requirements of the Contract.

Prior to the beginning of any acceptance testing at a given CCTV system site, complete all configuration and documentation associated with GDOT's "ATMS Surveillance Camera Control Integration and Calibration Procedure," described in Subsection 936.3.05.B. Be prepared to demonstrate such work.

B. Field Installation Test

Perform the Field Installation Test as an onsite test of the complete field installation assembly less the communications components; no acceptance testing at a given site can begin until all work associated with that site is complete, not including the communications components. For the field equipment installation test, use a PC system, CCTV Embedded Protocol control software, and a 13 in or larger color video monitor to demonstrate full operation of the CCTV site. Demonstrate operation to include pan, tilt, focus, zoom, iris, position feedback, and communications address configuration. Measure the video signal strength at the video connector of the communications equipment.

C. CCTV System Site Test

For the CCTV System Site Test, demonstrate proper CCTV system performance at the TMC or other control center determined by the Department. Perform the CCTV System Site Test only after successful completion of the field installation acceptance test. Demonstrate the complete video image, camera/lens control, and communications operation from each CCTV site to the TMC. Use the NaviGator software and existing NaviGator control center and communications system to demonstrate the compatibility of the CCTV equipment and installation in its permanent NaviGator configuration. Verify data communications (pan, tilt, focus, zoom, iris, position feedback) from the TMC as defined in the Department-approved test procedures.

D. Burn-in Period

1. General Requirements

Provide a 30-day burn-in period for all work and equipment included in the Contract. The burn-in period shall consist of the field operation of the CCTV system in a manner that is in full accordance with the CCTV system requirements of the Plans and Specifications. An acceptance test procedure is not required for the system burn-in.

Conduct only one (1) burn-in period on the entire Contract. Commence with the burn-in period only after meeting all of the following requirements:

- All work required in all Contract documents for CCTV (may be combined with construction contract) (except this burn-in period) has been completed and inspected by the Engineer.
- ~~Successfully complete all Acceptance Testing.~~

Commence with the burn-in period upon written authorization by the Department to commence. Terminate the burn-in period 30 consecutive days thereafter unless an equipment malfunction occurs. Stop the burn-in period for the length of time any equipment is defective. After repairing the equipment so that it functions properly, resume the burn-in period at the point it was stopped.

Successful completion and acceptance of the burn-in period will be granted on the 30th day unless any equipment has malfunctioned during the 15th through 30th day of the burn-in period. If any equipment has failed during the 15th through 30th day, final acceptance will be withheld until all the equipment is functioning properly for 15 days after repair.

When a specific piece of equipment has malfunctioned more than three times during the 30 day burn-in period, replace that equipment with a new unit and repeat the 30 day burn-in period.

2. Contractor Responsibilities

During the burn-in period, maintain all work under this Contract in accordance with the Specifications. Restore any work or equipment to proper operating condition within 12 hours after notification.

3. Department Responsibilities

Department responsibilities during the burn-in period will be as follows:

- Expedient notification of Contractor upon failure or malfunction of equipment
- In the event that the Contractor does not provide the services enumerated above under his Contract responsibilities, the Department or its authorized agents may in the interest of public safety take emergency action to provide for adequate traffic control. Pay any costs incurred as a result of these emergency actions. Such action by the Department will not void any guaranties or warranties or other obligations set forth in the Contract.

4. Burn-In Period Acceptance

The Department will make burn-in period acceptance after satisfactory completion of the required burn-in period and on the basis of a comprehensive field inspection of the complete CCTV system in accordance with the Specifications. Upon burn-in period acceptance but prior to Final Acceptance of the entire Contract, maintain the complete CCTV system in accordance with the requirements of Subsection 936.3.07.

E. Bench Acceptance Test

Perform the bench acceptance test as an onsite test of the complete retrofit assembly for all assemblies furnished as shown in the Plans. Furnish a benchtop stand and associated hardware for the camera system assembly mount that securely holds the camera system assembly while the camera is being operated. For the bench acceptance test, use a PC system, CCTV Embedded Protocol control software, and a 13 in or larger color video monitor to demonstrate full operation of the CCTV site. Demonstrate operation to include pan, tilt, focus, zoom, iris, position feedback, and communications address configuration. Measure the video signal strength at the video connector of the communications equipment end of cable C4. At the successful completion of the bench acceptance test, repack all materials in the shipping packaging required in Subsection 936.2.04.

936.3.07 Contractor Warranty and Maintenance

Provide a manufacturer's support (usual and customary warranties) period for all equipment and materials furnished and installed as part of the pay item for CCTV system equipment and materials. Include warranties or guarantees for system camera assembly and mount, cabinet interface assembly, and cabling/connector. Begin warranty upon successful completion of the CCTV System Site Test or Bench Acceptance Test.

Transfer Manufacturer's and Contractor's warranties or guarantees to the agency or user responsible for the CCTV system maintenance. The warranties and guarantees shall be continuous throughout their duration, and state that they are subject to such transfer.

936.3.08 Training

Provide installation, operations, and maintenance training on the CCTV equipment at a site in the project area. Personnel trained by the various equipment manufacturers and authorized by said manufacturers shall perform the training. Include in the cost of training all supplies, equipment, materials, handouts, travel, and subsistence necessary to conduct the training. Furnish a training notebook in a labeled 3-ring binder to each trainee.

Provide installation, operations and maintenance training for up to twelve (12) people. Include in this training both classroom training and hands-on training. Limit in-shop and in-field training to group sizes of four (4) people at a time. Conduct all training in half-day sessions. Two half-day sessions may be held on the same day. The total of the training shall consist of at least six (6) clock hours of training for each participant. Provide a course content of, at a minimum, the following:

- Installation of all CCTV equipment
- Operations of all CCTV equipment
- Explanation of video quality
- Maintenance of all CCTV components
- Use of the CCTV embedded protocol control software
- Measurement of video signals
- Discussion of all warranty clauses
- Hands-on use of CCTV equipment in signal shop environment for each trainee
- In-field maintenance training

CCTV training shall be provided in conjunction with the digital video transport system training specified in Section 939. The total of the CCTV and video transport system training shall consist of at least eight (8) clock hours of training for each participant. Meet all video transport system training requirements of Section 939.

936.4 Measurement

936.4.01 CCTV System, Type B

CCTV systems, Type B, are measured for payment by the number actually installed, complete, functional, and accepted. Unless otherwise specified in the Plans, furnish and install the following minimum items for a CCTV system, Type B:

- camera system assembly including the camera, lens, pan/tilt drive, control electronics and environmental enclosure.
- pole-mounting hardware.
- cabinet equipment, including but not limited to the cabinet interface assembly and all associated wiring, conductors, terminal blocks, and surge suppression.
- all weather heads, vertical conduit risers and conduit hardware on the CCTV support pole for power service, grounding, communications and control.
- all cables, connectors, hardware, interfaces, supplies, and any other items necessary for the proper operation and function of any CCTV system component with any other CCTV system component.

936.4.02 CCTV System, Type B, Retrofit Assembly

CCTV Systems, Type B, Retrofit Assembly are measured for payment by the number actually installed, complete, functional, and accepted. Unless otherwise specified in the Plans, furnish and install the following minimum items for a CCTV System, Type B, Retrofit Assembly:

- removal and disposal, or removal, salvage and delivery, of all existing CCTV equipment.
- camera system assembly including the camera, lens, pan/tilt drive, control electronics and environmental enclosure.
- pole-mounting hardware.
- cabinet equipment, including but not limited to the cabinet interface assembly and all associated wiring, conductors, terminal blocks, and surge suppression.
- any weather heads, vertical conduit risers and/or conduit hardware on the CCTV support pole for grounding, communications and control cabling included in or affected by the installation of the retrofit assembly.
- all cables, connectors, hardware, interfaces, supplies, and any other items necessary for the proper operation and function of any CCTV system component with any other CCTV system component.

936.4.03 CCTV System, Type B, Retrofit Assembly (Furnish Only)

CCTV Systems, Type B, Retrofit Assembly (Furnish Only) are measured for payment by the number actually furnished, delivered, complete, functional, and accepted. Unless otherwise specified in the Plans, furnish and install the following minimum items for a CCTV System, Type B, Retrofit Assembly (Furnish Only):

- camera system assembly including the camera, lens, pan/tilt drive, control electronics and environmental enclosure.
- pole-mounting hardware including round pole adapter, attachment hardware, and mounting straps.
- cabinet equipment, including but not limited to the cabinet interface assembly and all associated wiring, conductors, terminal blocks, surge suppression, and fastening hardware.
- packaging for shipping and storage.
- all cables, connectors, hardware, interfaces, supplies, and any other items necessary for the proper operation and function of any CCTV system component with any other CCTV system component.

936.4.04 Testing

Testing is measured as a lump sum for full delivery of testing and acceptance requirements.

936.4.05 Training

Training is measured as a lump sum for all supplies, equipment, materials, handouts, travel, and subsistence necessary to conduct the training.

936.4.06 Limits

Not applicable

936.5 Payment

936.5.01 CCTV System

CCTV systems of the Type specified in the Plans are paid for at the Contract Unit Price. Payment is full compensation for furnishing and installing or delivering the CCTV system.

Payment for CCTV systems is made under:

Item No. 936	CCTV System, Type B	Per Each
Item No. 936	CCTV System, Type B, Retrofit Assembly	Per Each
Item No. 936	CCTV System, Type B, Retrofit Assembly (Furnish Only)	Per Each

936.5.02 Testing

The Department will pay for testing performed as prescribed by this Item, measured as provided under Measurement at the Lump Sum Contract bid price.

Payment for testing is made under:

Item No. 936	Testing	Lump Sum
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936.5.03 Training

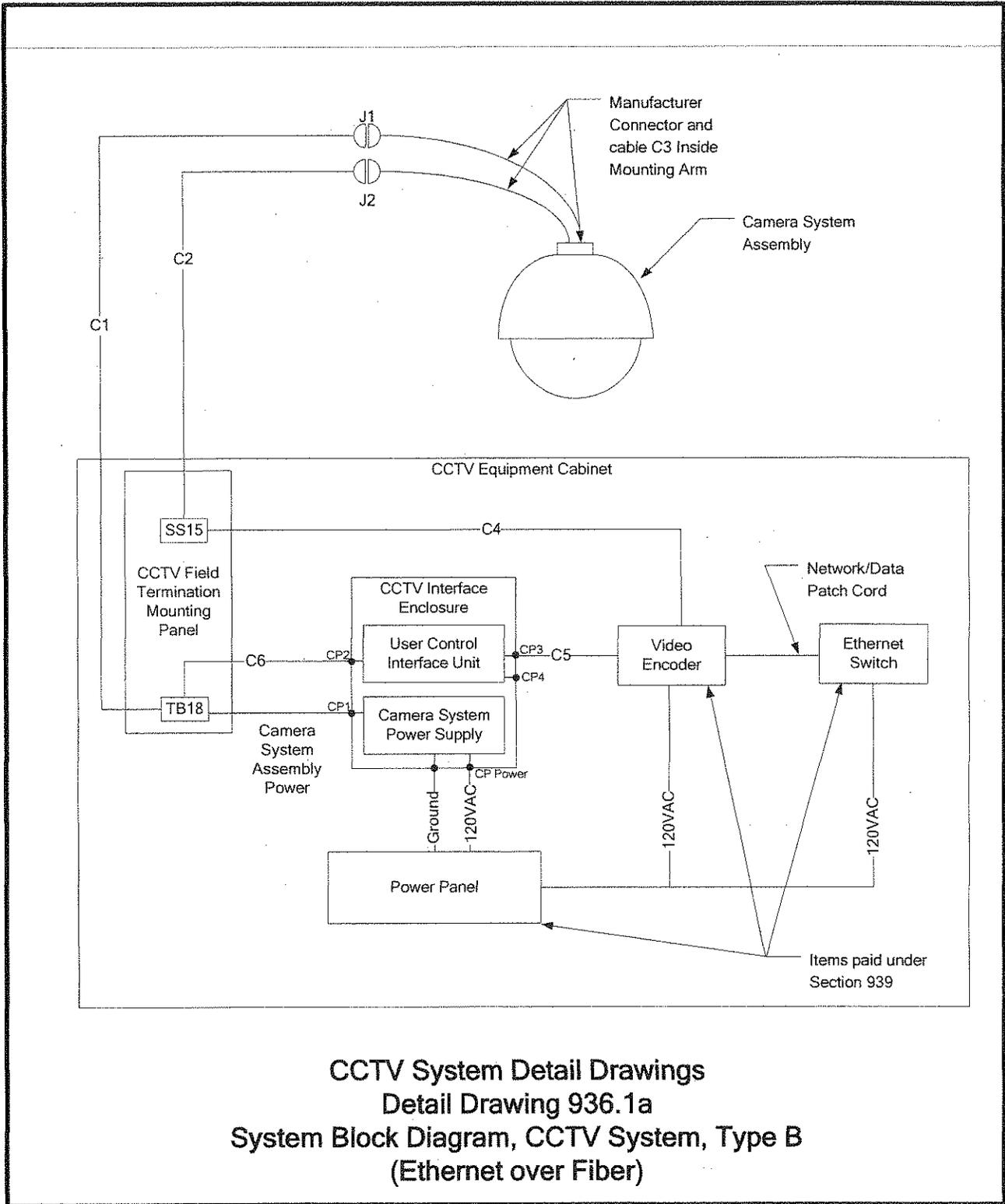
The Department will pay twenty-five (25%) of the total contract bid amount for training upon approval of the Training Plan. The Department will pay the remaining seventy-five (75%) after completion of all training as described in Subsection 936.3.08. The total sum of all payments cannot exceed the original contract amount for this item.

Payment for training is made under:

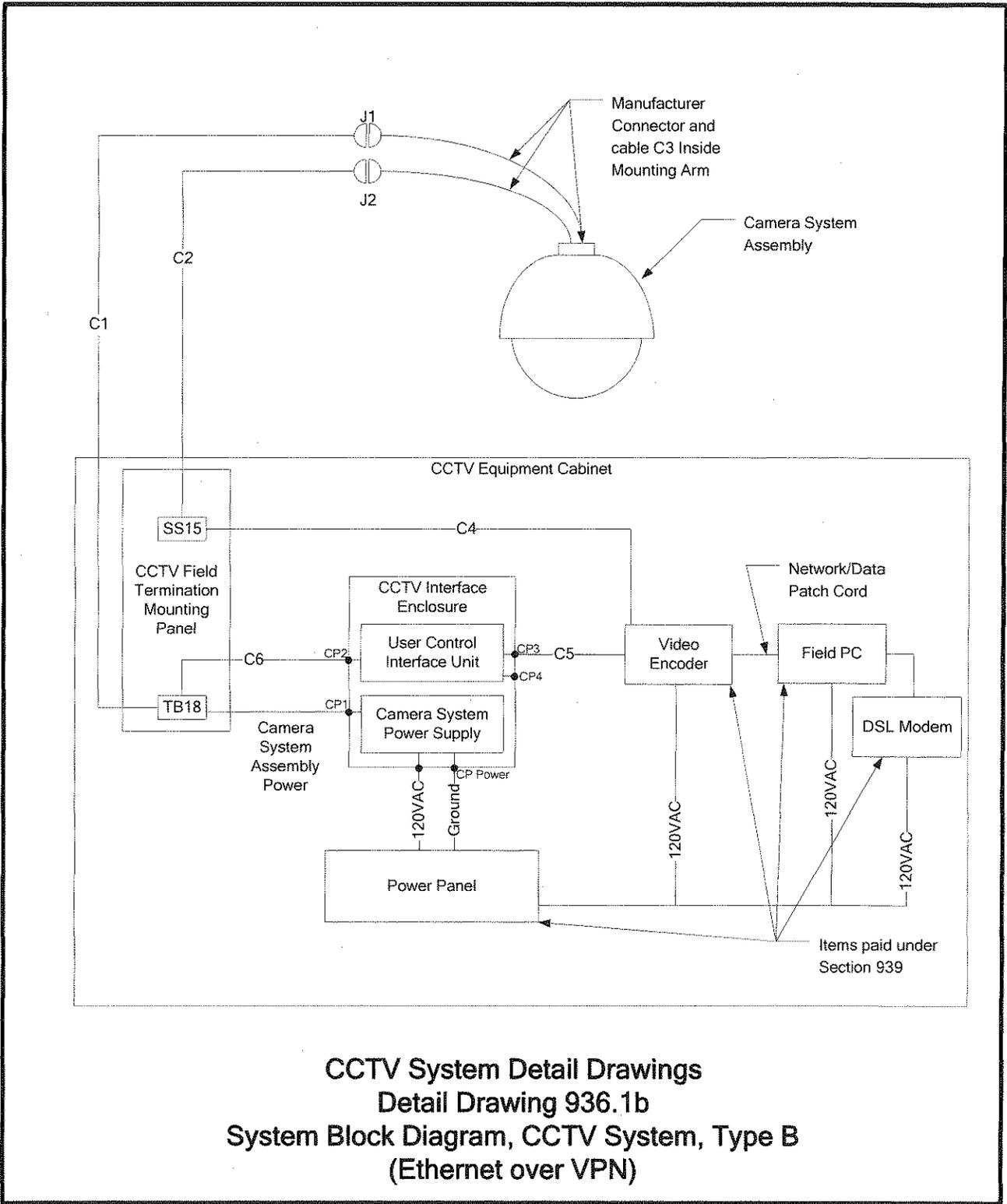
Item No. 936	Training	Lump Sum
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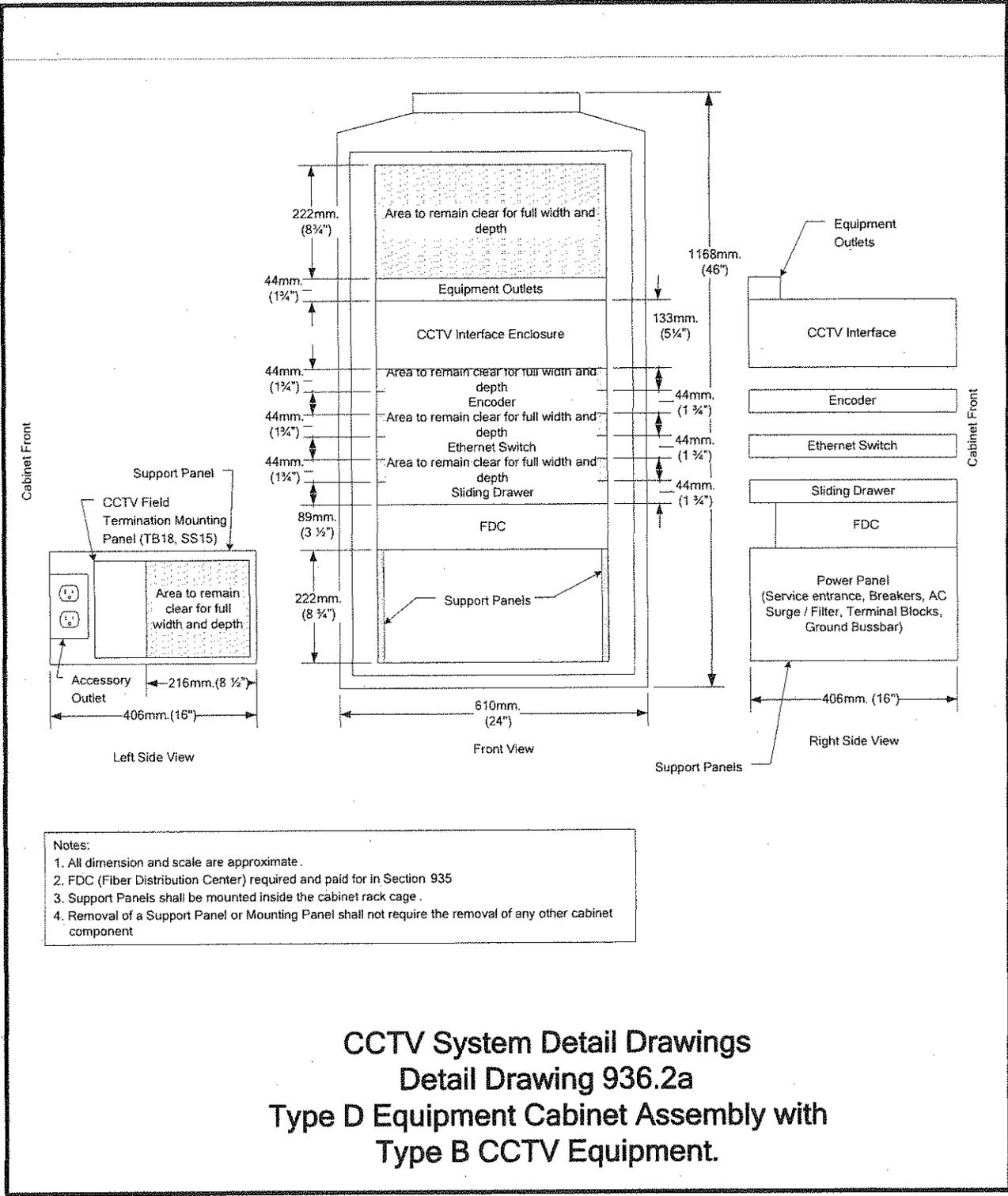
936.5.04 Adjustments

Not applicable



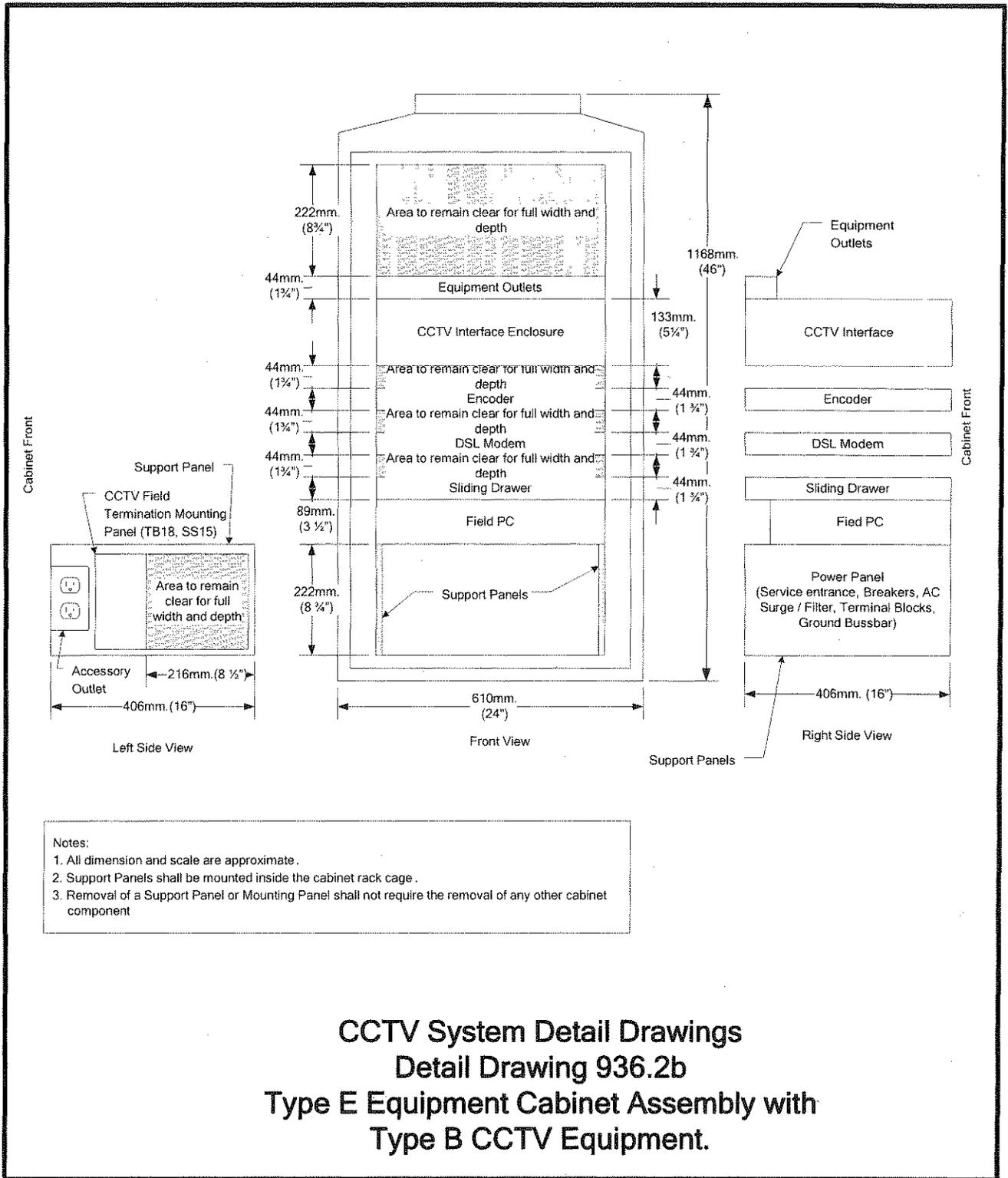
**CCTV System Detail Drawings
Detail Drawing 936.1a
System Block Diagram, CCTV System, Type B
(Ethernet over Fiber)**

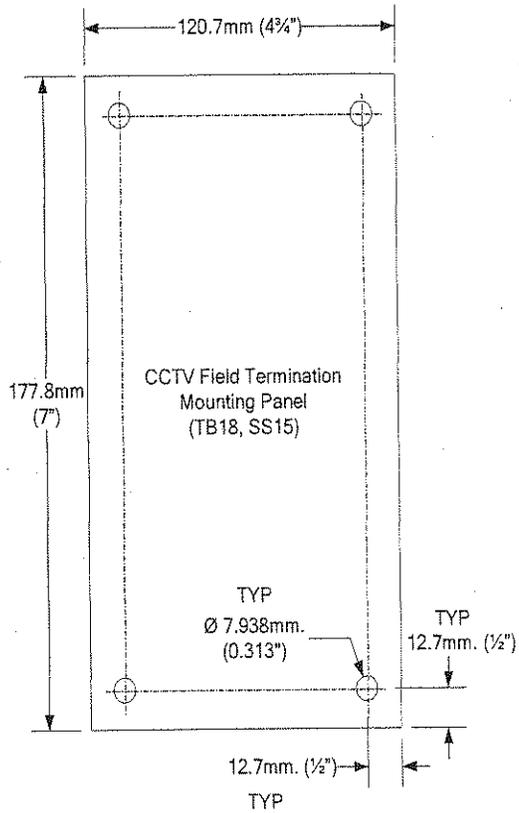




- Notes:
1. All dimension and scale are approximate.
 2. FDC (Fiber Distribution Center) required and paid for in Section 935
 3. Support Panels shall be mounted inside the cabinet rack cage.
 4. Removal of a Support Panel or Mounting Panel shall not require the removal of any other cabinet component

CCTV System Detail Drawings
Detail Drawing 936.2a
Type D Equipment Cabinet Assembly with
Type B CCTV Equipment.

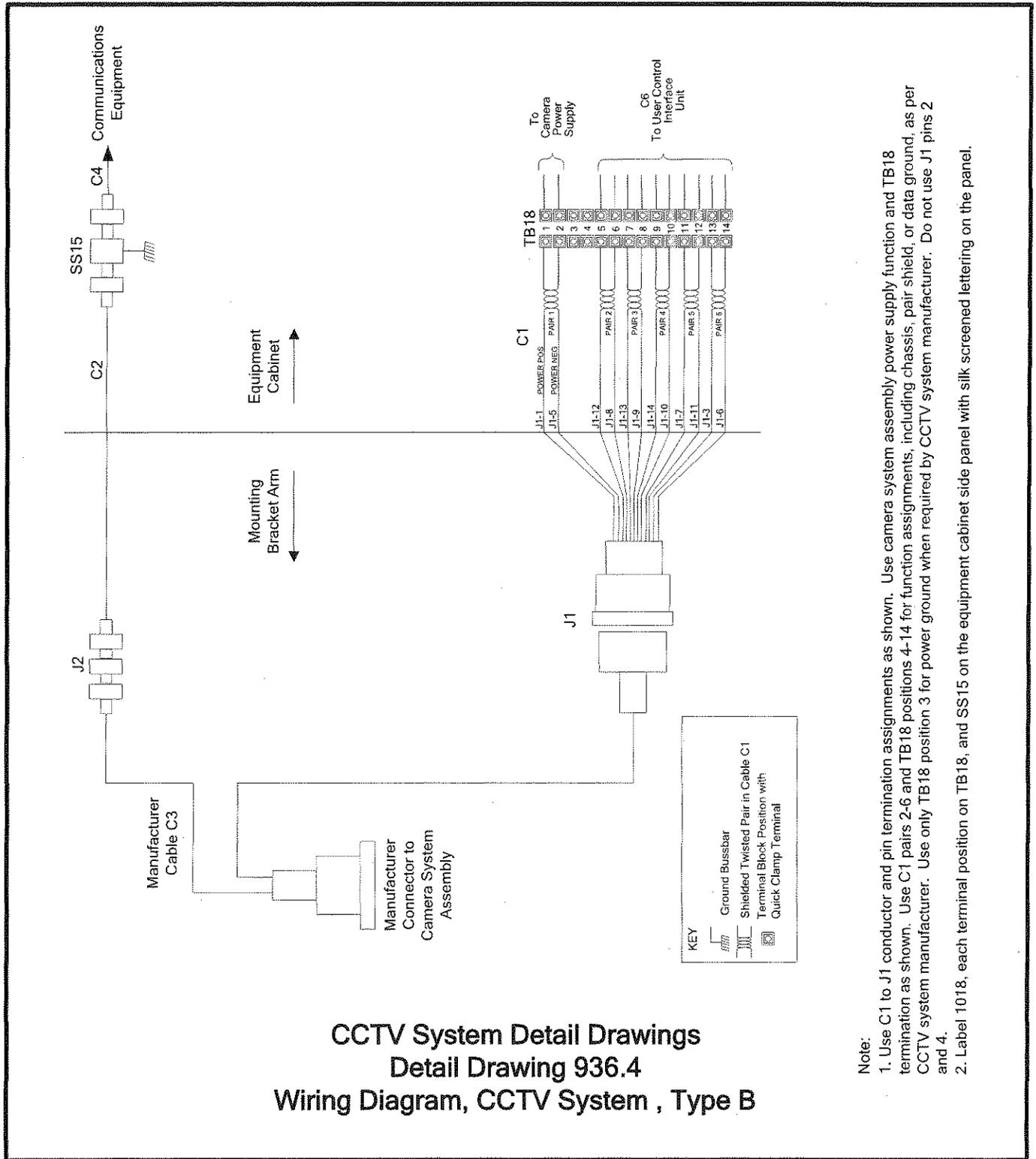


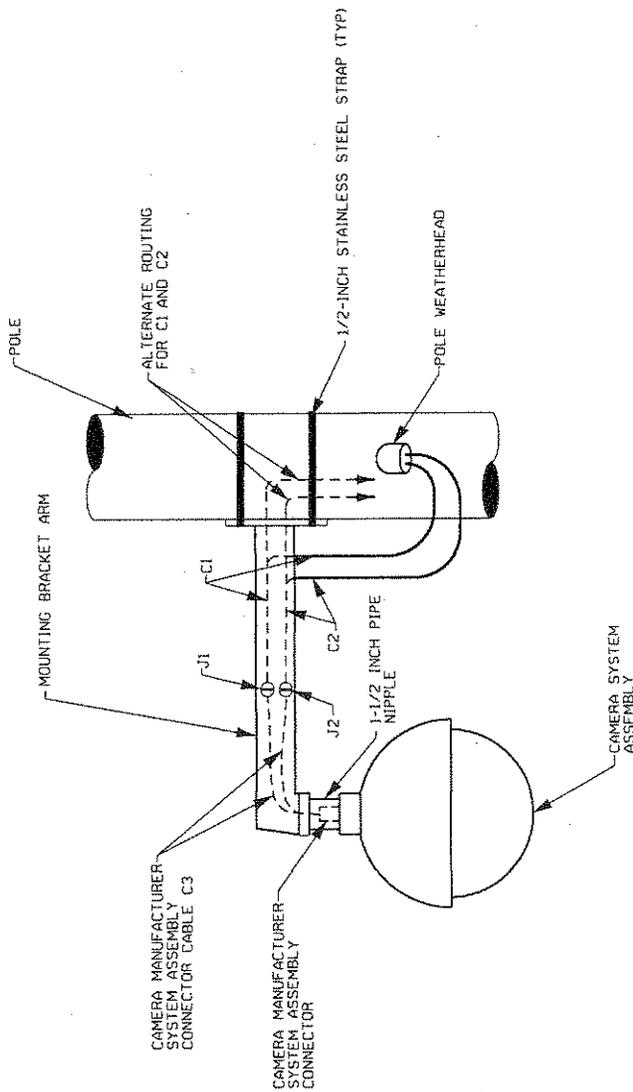


Note:

1. All linear dimensions +/- 0.005" tolerance.
2. Drawing not to scale
3. Mounting Panel shall be 0.125" 5052 Aluminum

CCTV System Detail Drawings
Detail Drawing 936.3
CCTV Field Termination Mounting Panel,
CCTV System Type B





Detail Drawing 936.5
 Pole Mounting Detail, CCTV System, Type B
 Not To Scale

DATE	BY	REVISIONS

GEORGIA DEPARTMENT
 OF TRANSPORTATION

TITLE
 CCTV SYSTEM DETAIL DRAWINGS

SCALE:
DATE:
SHEET:

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**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA**

SPECIAL PROVISION

P.I. No.: 0010290 & 0010311

Fulton County

Forsyth County

Section 937 - Video Detection System

Delete Section 937 and substitute the following:

Section 937 – Video Detection System

937.1 General Description

This Work includes the procurement and installation of a vehicle detection system as shown in the plans. Ensure the vehicle detection system is capable of vehicle presence detection and traffic data collection meeting the general and specific requirements of this special provision. Ensure the firmware and software furnished and installed as part of an Intelligent Transportation System (ITS) project are the most current and approved releases or versions. Provide all equipment, materials, and work in accordance with all manufacturers' recommendations. All equipment, cables, and hardware must be part of an engineered system that is designed by the manufacturer to fully interoperate with all other system components.

Provide a vehicle detection system which produces vehicle presence, volume, speed, and occupancy data for each detected lane. Provide a vehicle detection system utilizing one of the following technologies as shown in the plans:

A. Video Detection

Install a video detection system which provides presence detection, vehicle counts, roadway occupancy, classification, and speed information to the Department's NaviGator Intelligent Transportation System. The video detection system includes, but is not limited to, camera image sensor(s), including the detector housing, mounting hardware, an application programming interface (API) and protocol for system communications, a video detection system processor, system management software, cabling between the detector and the cabinet, surge suppressors, terminations, and related equipment. The video detection system processors communicate through an Ethernet interface and TCP/IP (transmission control protocol/Internet protocol) connection to multiple Transportation Management Center (TMC) computers. The video detection system is typically used for gathering near real-time information about the flow of traffic on freeways, highways, or other designated roadway types.

B. Microwave Detection

Install a microwave radar detection system which provides presence detection, vehicle counts, classification, occupancy, and speed information to the Department's NaviGator Intelligent Transportation System (ITS). The microwave radar detection system includes, but is not limited to, microwave/ radar detectors, including detector housing, mounting hardware, an application programming interface (API) and protocol for system communications, system management software, cabling between the microwave detector(s) and the cabinet, surge suppressors, terminations, and related equipment. Microwave detection systems are typically used for gathering near real-time information about the flow of traffic on freeways, highways, or other designated roadway types.

C. Intersection Video Detection (I-VDS)

Install an Intersection Video Detection System (I-VDS) for use with traffic signal/ramp meter controllers in a traffic signal or ramp meter cabinet with card rack vehicle detector input files. The I-VDS system to be supplied uses one or more video cameras to collect and analyze video signals for detecting vehicle presence and passage, generating volume, occupancy, and speed data. The I-VDS includes, but is not limited to, video camera sensors, including the camera sensor housing and mounting hardware, intersection video detection system processor modules, system management software, output expansion modules which mount in the traffic signal controller cabinet input files, programming monitors, programming devices for system configuration through software, cabling between cameras sensors and the cabinet, surge suppressors, terminations, and related equipment.

937.1.02 Definitions

General Provisions 101 through 150.

937.1.03 Related References**A. Standard Specifications**

Section 150 – Traffic Control

Section 639 – Strain Poles for Overhead Sign and Signal Assemblies

Section 647 – Traffic Signal Installation

Section 922 – Electrical Wire and Cable

Section 925 – Traffic Signal Equipment

Section 939 – Communication and Electronics Equipment

Section 940 – NaviGator Advanced Transportation Management System Integration

B. Referenced Documents

American National Standards Institute (ANSI)

American Society of Testing and Materials (ASTM)

EIA-170A

Electronic Industries Association (EIA) - 170A

FCC Part 15, Subpart J, Class A device requirements

Georgia DOT SOP 17 & 42

Highway Capacity Manual (current edition)

Manual on Uniform Traffic Control Devices (current edition)

National Electric Code (NEC) 210-19a., FPN No. 4

National Electrical Manufacturers Association (NEMA) TS1-1989 (R1994, R2000, R2005), Section 2.1.5.2, Section 2.1.12

NEMA TS-1-1989 (R1994, R2000, R2005)

NEMA TS2-2003 Type 2, Type 170 and Type 179 Standards

NEMA TS2-2003

NEMA 250 Type 4 enclosure standards

Underwriter's Laboratory Incorporated (UL) Submittals

937.1.04 Submittals

The following charts provide the Contractor with an outline of the submittal requirements for the equipment and components for the following pay items. This chart is to be used as a guide and does not relieve the Contractor from submitting additional information to form a complete submittal package. Provide submittal data for all equipment, materials, test procedures, and routine maintenance procedures required for these items as required in these Special Provisions.

Video Detection System Submittal Requirements								
Material	Specification Reference	Catalog Cuts	Mfg. Spec.	Materials Cert.	Lab. Test Reports	Install. Proced.	Maint. Proced.	Warranty
Video Camera Sensor	937.2.01 A	X	X	X	X	X	X	X
Video Detection System Processor (All Types)	937.2.01A2b	X	X	X	X	X	X	X
Cabinet Eqpt	937.3.01.A3	X	X	X	X	X		X

Microwave Detection Submittal Requirements										
Material	Specification Reference	Catalog Cuts	Mfg. Spec.	Materials Cert.	Lab Test	Install. Proced.	Test Plan	Maint. Proced.	Warranty	Submittal Due Date (Cal. Days after NTP)
Detector	937.2.02.A1	X	X	X	X	X	X	X	X	60 Days
Housing	937.2.02.A2	X	X	X	X		X	X	X	60 Days
Mounting Assembly	937.2.02.A3	X	X	X			X		X	60 Days

Intersection Video Detection Submittal Requirements														
Material	Specification Reference	Catalog Cuts	Mfg.	Shop.	Structural	Lab Test	Installation	Mainten.	Test	Test Plan	Test Reports	Training	Warranty	Submittal Due Date (Calendar Days after NTP)
Video Camera	937.2.03.A.1	X	X			X	X	X		X				60 Days
Video Camera Enclosure	937.2.03.A.1i	X	X			X	X	X		X				60 Days
Variable Focus Lens	937.2.03.A.1d	X	X			X	X	X		X				60 Days
Programming Monitor	937.2.03.A.2	X	X											60 Days
Programming Device	937.2.03.A.3	X	X											60 Days
Processor Module	937.2.03.A.4	X	X	X		X	X	X		X				60 Days
Output Expansion Module	937.2.03.A.5	X	X	X		X	X	X		X				60 Days
Processor Software	937.2.03.B.3	X	X				X	X		X				60 Days
Configuration Software	937.2.03.B.3b	X	X				X	X		X				60 Days
Terminal Blocks	937.3.02.A.3a	X	X							X				60 Days
Surge Suppression	937.3.02.A.3b	X	X	X			X	X		X				60 Days
Wiring Cabling & Harnesses	937.2.03.A.1j 937.3.01.A	X	X	X			X	X		X				60 Days
Training Plan	937.3.01											X	X	60 Days

For Video Detection Systems (VDS) and Microwave Detection, submit to the Engineer for approval, two (2) hard copies of the manufacturer's descriptive literature (catalog cuts), technical data, operational documentation, service and maintenance documentation and all other materials required within these specifications and also an electronic copy, which includes all the aforementioned documents, shall be placed on a CD as pdf documents and delivered to the Engineer.

For Intersection Video Detection (I-VDS), submit to the Engineer for approval, eight (8) hard copies of the manufacturer's descriptive literature (catalog cuts), technical data, operational documentation, service and maintenance documentation and all other materials required within these specifications and also an electronic copy, which includes all the aforementioned documents, shall be placed on a CD as pdf documents and delivered to the Engineer.

Products appearing on the Qualified Products List (QPL) are exempt from normal submittal requirements. These products have been evaluated by the Office of Traffic Operations and have proven their capability of meeting the appropriate Georgia Department of Transportation Specification. Any of these products may be used without submitting catalogue cuts, sampling or pre-testing. The Contractor shall submit a letter to the Field Engineer, stating which QPL items they will use. The Field Engineer and/or department designee must ascertain that the construction item is the same material identified on the appropriate QPL and will acknowledge receipt of these items in the project diary or as required by the Construction manual.

Provide as-built documentation of all detector installations after the completion of field tests.

937.2 Materials

937.2.01 Video Detection System

Use a video camera sensor that is compatible with the video detection system processor and meets the following technical and functional requirements:

A. Technical Requirements

1. Video Camera Sensor

- a. Lens: Lens must be housed in an environmentally sealed enclosure, watertight, protected from dust, and must comply with the most current NEMA 4 standards. Video sensor must have a motorized lens with variable focus and zoom control. Focal length must allow ± 50 percent adjustment of the viewed detection scene.
- b. Input power: Ensure the vehicle detection system operates using a nominal input voltage at the field cabinet of 120 volts (AC). Ensure that the system's power supply will operate with an input voltage ranging from 89 to 135 volts (AC). For any device requiring a source input other than the standard 120 VAC, supply the appropriate means of conversion.
- c. Video camera sensor enclosure: Install the video camera sensor in a light colored enclosure to limit solar heating. Meet NEMA 250 type 4 enclosure standards. An adjustable sun shield that diverts water from the field of view shall also be included. Include a provision for waterproofing the connection of power, control, video signal cables, and wiring on the camera enclosure.
- d. Weight: 10 lbs maximum including mount, shield, and camera.
- e. Mounting: Ensure that the video camera sensor assembly, enclosure, and sun shield can be mounted using manufacturer's recommended hardware. The video camera sensor horizon shall be adjustable without removing the camera, mounting bracket and enclosure, or sun shield.

2. Video Detection System Processor

a. Mounting

Ensure the video detection system processor is rack mountable in a standard 19-inch rack assembly space conforming to Standard CEA-310, 2005, latest version/addendum, attaches to both sides of the rack, is not more than 10 inches (254 mm) deep, and is not more than 7 inches (178 mm) high. The video detection system processor shall be designed for mounting in an enclosed cabinet and/or Hub building without blower fans and mounting without insulation from other electronic devices such as power supplies, communications equipment, etc. The video detection system shall meet NEMA TS-2 temperature requirements.

b. Electrical and Power Requirements

Power the video detection system processor by 120 VAC, 60 Hz, single phase, and draw a maximum of 1.0 A. Size power conductors from the power source for the video detection system processor input so that no more than a 3% voltage drop is experienced (NEC 210-19 a., FPN No. 4). The video detection system processor shall have transient protection that meets the requirements of NEMA TS1-1989 (R1994, R2000, R2005) and NEMA TS2-2003 standards.

Power to the video detection system processor shall be from the cabinet equipment outlet.

1) Video Detection System Processor, Type A

- a) Provide at least two (2) video inputs on the video detection system processor such that signals from up to two (2) video camera sensors or other synchronous or non-synchronous video sources can be processed in real time. Use BNC connectors on the back of the video detection system processor for all video inputs. Use a BNC connector on the front or back of the video detection system processor for video output.

2) Video Detection System Processor, Type B

- a) Provide at least four (4) video inputs on the video detection system processor such that signals from up to four (4) video camera sensors or other synchronous or non-synchronous video sources can be processed in real time. Use BNC connectors on the

back of the video detection system processor for all video inputs. Use a BNC connector on the front or back of the video detection system processor for video output.

c. Environmental Requirements

1) Video Detection System Processor, Type A

Provide a video detection system processor that operates reliably in a typical roadside traffic cabinet environment. Provide internal cabinet equipment and a video detection system processor that meet the environmental requirements of NEMA TS1-1989 (R1994, R2000, R2005).

2) Video Detection System Processor, Type A

- a) Operating ambient temperature range: -30°F to 140°F (-34°C to 60°C). Additionally, include a heater to prevent the formation of ice and condensation in cold weather. Do not allow the heater to interfere with the operation of the video camera sensor electronics, or cause interference with the video signal.
- b) Humidity range: 5-95% humidity per NEMA TS1-1989 (R1994, R2000, R2005), Section 2.1.5.2.
- c) Vibration: Do not allow vibration to impair performance when the camera is mounted on 96 ft (29 m) or shorter pole. Provide a video camera sensor and enclosure that maintains its functional capability and physical integrity when subjected to a vibration of 5 to 30 Hz up to 0.5 gravity applied to each of three mutually perpendicular axes (NEMA TS1-1989(R1994, R2000, R2005), Section 2.1.12).
- d) Shock: Ensure the video camera sensor & enclosure can withstand a 10G±1G shock. Neither permanent physical deformation nor inoperability of the video camera sensor and enclosure can be sustained as a result from this shock level.
- e) Acoustic Noise: Provide a video camera sensor and enclosure that can withstand 150 dB for 30 minutes continuously, with no reduction in function or accuracy.

B. Functional Requirements for Vehicle Detection Systems

In order to be approved for use in GDOT projects, a detection product must be able to provide certain data elements at or better than a minimal defined accuracy level. This section defines the minimally required functional aspects of the system as well as the required accuracy levels. It also outlines the testing process that will be used to determine whether a proposed video detection system product meets these specifications.

1. Ensure that Video Detection Systems proposed for use in the Navigator system provides vehicle presence, speeds, vehicle counts and roadway occupancies on a lane-by-lane basis. Verify that the system can emulate the output of a pair of 6 ft. by 6 ft. in-pavement loops spaced 16 ft apart. Ensure that the Video Detection System is capable of providing the above data for seven (7) lanes plus two shoulders with one video camera sensor. Verify that the system responds with the accumulated traffic data as collected since the last request.
2. Verify that the detection system is IP-addressable and that all communication addresses are user programmable. Ensure the setup program assigns an IP address to the detection processor. Ensure that communications to the system are either in serial format using an Electronic Industries Alliance (EIA) standard EIE-232 communication or an Internet Protocol (IP) interface as approved by GDOT's Information Technology group. Ensure the system supports Point-to-Point Protocol (PPP), Point to Multi-Point Protocol (PMPP) and Ethernet Protocols.
3. Verify that the traffic data collected by the Video Detection System is stored within internal non-volatile memory within the video detection system processor. Perform software updates through an Ethernet, serial, or USB port. Verify that data can be retrieved from the system either locally or via requests from computers at the central Transportation Management Center (TMC) over the communications network. Verify that the system configuration data and system software is also stored within internal non-volatile

memory within the video detection system processor. Perform software updates through an Ethernet, serial, or USB port

4. Ensure the video detection system processor front panel includes a visual display of the status of each video input. Indicators shall display, at a minimum, the status of video detection system processor communications, the status of the video detection system processor, the status of communications, and whether or not each video camera sensor is actively detecting. Include an Embedded HTTP Server in the video detection system processor. The Embedded HTTP Server shall allow a remote user with a standard web browser to gain remote access, collect data, control, and configure the VDS.
5. Ensure the Video Detection System includes computer software, which enables the user to program, calibrate, operate and view current status of all system features using a laptop computer, or network-connected workstation at the central TMC. Ensure the system allows the user to view live video from the image sensor with the programmed detectors overlaying the image. Ensure individual vehicle actuations can be viewed while observing the live video.
6. Ensure the Video Detection System configuration data can be uploaded and saved to a laptop or TMC workstation computer for later re-loading to the video detection processor if necessary.
7. Ensure that the system offers an open Application Programming Interface (API) and software development kit (SDK) for GDOT developers and their consultants to integrate the Video Detection System with Navigator Central Software or other third-party software and systems. Furnish needed software licenses for the system.
8. Furnish software that is compatible with the Department's Navigator traffic management system software and that any software associated with the Video Detection System does not adversely affect the operation of the overall Navigator system.
9. Ensure the system user can use a laptop to reprogram, calibrate, adjust or alter any previously defined detector configurations in the field and also reprogram any detector configurations over the network or from a TMC workstation. Ensure no periodic adjustments or fine-tuning is required except in the case of physical roadway changes such as lane-shifts, new construction or closures. Initial configuration of the detection system shall be done with a programming device that is either a keyboard/keypad or stationary track ball pointing devices. Connect the programming device to the front of the processor module through a USB, DB9, or PS/2 connector. Provide a programming device that is PC compatible.
10. Provide software that can communicate concurrently between multiple users and multiple video detection processors on the same network without any interruption or conflict with the normal polling cycle.

C. Accuracy Requirements for Video Detection Systems

Provide a Video Detection System that meets the below minimum accuracy requirements for both daytime and night time conditions:

1. For volume (vehicle counts): 95% (no more than 5% missed actuations).
2. For speed measurement: 95% (no more than 5% error in speed calculation)
3. For occupancy measurement: 95% (no more than +/- 5% missed actuations)
4. For presence detection: 95% (no more than +/- 5% error in missed actuations)

D. Testing

Vendors are required to submit an independent test evaluation reports from a third party which verifies the accuracies stated within their specifications.

Independent third-party verification (ITPV) is defined as the evaluation of the conceptual, functional, and technical requirements of a product being reviewed by one or more independent third parties qualified by their education,

training, and experience in the same discipline, to judge the worthiness of the products' likelihood of achieving the intended objectives and anticipated outcomes.

Develop and submit plans for pre-installation and post-installation testing to the Engineer for consideration and approval. Ensure the plans test all functional requirements outlined in Section 937.2.01B and the accuracy requirements stipulated in Section 937.2.01C. Provide the Engineer with Application Protocol Interface (API) documentation and Software Development Kit (SDK) for the video detection system.

GDOT project engineer will provide this documentation to GDOT Information Technology (I.T.) staff or GDOT's designated software consultant for review and determination that the proposed Video Detection System includes an API that is acceptable for integration with the Navigator Intelligent Transportation System. GDOT will have 30 days from receipt of the API and SDK to make this determination. GDOT is not required to write the full Detection System interface to Navigator at this point in the testing process.

1. Pre-installation test requirements: Include at a minimum the following procedures in the test plan to demonstrate the Video Detection System provides all the functional requirements in Section 937.2.01B and meets the accuracy requirement stipulated in Section 937.2.01C. Installation of detection systems will not begin until the pre-installation test requirements have been successfully completed.
 - a. Install a test video detection system at a location determined by GDOT. Install a new video sensor for the test. Install a test video detection system that includes all components of the system including a video sensor, a video detection processor and software.
 - b. Connect the Video Detection System processor to the GDOT communications network via a GDOT-provided field switch. Assign an IP address to the processor per GDOT's direction.
 - c. From the nearest Hub building, configure the Video Detection System processor to gather the data according to the requirements as specified in Section 937.2.01B.9. Verify that the configuration data is stored in non-volatile memory.
 - d. Demonstrate that each required data element is gathered by the system at the user-specified interval. Use 20-seconds as the interval for demonstration testing. Prove the accuracy of the detection system meets requirements in Section 937.2.01C by:
 - 1) Driving a vehicle of known speed and length through the detection zone and observing and recording the speed and length calculated by the system. Repeat this measurement at least ten times.
 - 2) Record fifteen minutes of traffic video from the image sensor at the same time the detection system is collecting data. Manually count the recorded traffic video and verify the count data calculated by the detection system meets the required accuracy requirements.
 - 3) Perform the above accuracy tests in both night and day conditions.
 - 4) Upon GDOT acceptance of pre installation test results, begin the installation of VDS as specified in the plans.
 - 5) If any part of the pre installation test fails, the contractor has up to two subsequent attempts to correct the problem to the satisfaction of the Engineer. All these subsequent tests must be completed within a two week period from the date of initial failure.
2. Post-installation test procedures: Utilize the following test procedures after the video detection system has been installed in its entirety as shown on the Plans. Commence no post-installation testing until all video detection systems in the project have been configured/calibrated to gather speed, volume and occupancy and programmed to communicate on the GDOT network. At this stage of testing, GDOT will be required to have in place the necessary interfaces to the Video Detection System.
 - a. Inspect all vehicle detection system field components to ensure proper installation and cable termination.
 - b. Verify that field construction has been completed as specified in the plans.
 - c. Inspect the quality and tightness of ground and surge protector connections.
 - d. Check power supply voltage and outputs and ensure device connections are as specified in the Plans.

- e. Verify that the installation of cables and connections between all detectors and field cabinets are as specified in the Plans
- f. Demonstrate that each Video Detection System is fully operational and gathering the required data types at the specified interval. Perform this test from the hub building through which the detection system is connected.
- g. Upon satisfactory completion of step f, GDOT will add the new video detection system(s) into the central NaviGATOR system
- h. Begin a 30-day burn test and ensure the system remains fully operational during the 30 day period as stipulated in Section 647.3.06.C.

937.2.02 Microwave Detection System

A. Technical Requirements

Provide a microwave detection system that meets the following minimum requirements:

1. Microwave Detector

- A frequency band of 10.525 GHz or approved spectral band must be used.
- The transmitter power cannot exceed 10 milli-watts
- Ensure compliance with the limits for a Class A digital device pursuant to Part 15 of the FCC rules
- A noise level less than 55 dBA when measured one meter away from the device is required
- Ensure the microwave detector operates on 12-24 VDC power provided. A power supply shall be included.

Ensure the detector uses one interface connector that provides power to the unit, contact closure wire pairs for each detection zone, and Ethernet communication lines for operations, programming, testing, or modem interface

- A coverage range between 10 and 200 feet is required.
- A diagnostic self-test of all detector functions shall be included.
- Data communications via Ethernet communications supporting TCP/IP Protocol must be provided.

Provide a microwave radar detector that operates under the following environmental conditions:

- Ambient temperature range of -29°F to 165°F (-37°C to 74°C)
- Relative humidity from 5 to 95 percent, non-condensing
- A power surge of ± 1kV surge (rise time = 1.2 μsec, hold = 50 μsec) should be applied in differential mode to all lines, power and output, as defined by IEC/EN 61000-4-5 standards
- Ensure the microwave detector is resistant to vibration in accordance with NEMA TS-1 (Section 2.1.12) or approved equivalent
- Ensure the microwave detector is resistant to shock in accordance with NEMA TS-1 (Section 2.1.13) or approved equivalent

2. Housing

Provide a microwave radar detector housing that meets the following requirements:

- Ensure compliance with the requirements of a NEMA type 3R enclosure
- The outside dimensions, including fittings, do not exceed 1,000 cubic inches (LxWxH).
- The total weight (including detector) does not exceed 8 pounds.

3. Mounting Assembly

Provide a microwave radar detector mounting assembly that meets the following requirements:

- The mounting assembly shall be all painted steel, stainless steel, or aluminum construction
- A minimum load of 20 pounds shall be supported.

4. Power Supply

Provide a power supply recommended by the microwave radar detector manufacturer that meets the following minimum requirements:

- A nominal output of 24VDC regulated with the ability to operate a minimum of 2 radar detectors simultaneously over an ambient temperature range of -29°F to 165°F (-34°C to 74°C) must be provided.
- A nominal input voltage of 120 VAC must be provided by the equipment cabinet power source
- The power supply shall be mounted to cabinet side panel, or as approved by the Engineer.

B. Functional Requirements for Microwave Detection Systems

In order to be approved for use in GDOT projects, a microwave detection system must be able to provide certain data elements at or better than a minimal defined accuracy level. This section defines the minimally required functional aspects of the microwave detection system as well as the required accuracy levels. It also outlines the testing process that will be used to determine whether a proposed microwave detection system product meets these specifications.

1. Ensure that Microwave Detection Systems proposed for use in the Navigator system provides vehicle presence, classification, speeds, vehicle counts and roadway occupancies on a lane-by-lane basis at a user definable reporting period between 20 to 600 seconds.
2. Verify that the system can emulate the output of a pair of 6 ft. by 6 ft. in-pavement loops spaced 16 ft apart. Ensure that the Microwave Detection System is capable of providing the above data for seven (7) lanes plus two shoulders with one microwave detector. Verify that the system responds with the accumulated traffic data as collected since the last request.
3. Verify that the detection system is IP-addressable and that all communication addresses are user programmable. Ensure the setup program assigns an IP address to the detection processor. Ensure that communications to the system are either in serial format using an Electronic Industries Alliance (EIA) standard EIE-232 communication or an Internet Protocol (IP) interface. Data communications are to be through Ethernet communications supporting TCP/IP Protocol. Ensure the system supports Point-to-Point Protocol (PPP), Point to Multi-Point Protocol (PMPP) and Ethernet Protocols. A diagnostic self-test of all detector functions should be included.
4. Verify that the traffic data collected by the Microwave Detection System is stored within internal non-volatile memory. Verify that data can be retrieved from the system either locally or via requests from computers at the central Transportation Management Center (TMC) over the communications network. Verify that the system configuration data and system software is also stored within internal non-volatile memory.
5. Ensure the Microwave Detection System includes computer software for the user to program, calibrate, operate and view current status of all system features using a laptop computer or network-connected workstation at the central TMC. Initial configuration of the detection system shall be done with a programming device that is either a keyboard/keypad or stationary track ball pointing devices. Connect the programming device to the front of the processor module through a USB, DB9 or PS/2 connector. Provide a programming device that is PC compatible. Ensure the system allows the user to view live actuations from the microwave detector with the programmed detectors overlaying a representation of the roadway.
6. Ensure the Microwave Detection System configuration data can be uploaded and saved to a laptop or TMC workstation computer for later re-loading to the video detection processor if necessary.
7. Ensure that the system offers an open Application Programming Interface (API) and software development kit (SDK) for GDOT developers and their consultants to integrate the Microwave Detection

System with Navigator Central Software or other third-party software and systems. Furnish needed software licenses for the system.

8. Furnish software that is compatible with the Department's Navigator traffic management system software and that any software associated with the Microwave Detection System does not adversely affect the operation of the overall Navigator system.

9. Ensure the system user can use a laptop or TMC workstation to reprogram, calibrate, adjust or alter any previously defined detector configurations. Ensure no periodic adjustments or fine-tuning is required except in the case of physical roadway changes such as lane-shifts, new construction or closures. Initial configuration of the detection system shall be done with a programming device that is either a keyboard/keypad or stationary track ball pointing devices. Connect the programming device to the front of the processor module through a USB, DB9 or PS/2 connector. Provide a programming device that is PC compatible. Provide software that can communicate concurrently between multiple users and multiple video detection processors on the same network without any interruption or conflict with the normal polling cycle.

C. Accuracy Requirements for Microwave Detection Systems

Provide a Microwave Detection System that meets the below minimum accuracy requirements for both daytime and night time conditions:

1. For volume (vehicle counts): 95% (no more than +/- 5% missed actuations).
2. For speed measurement: 95% (no more than +/- 5% error in speed calculation)
3. For occupancy measurement: 95% (no more than +/- 5% missed actuations)
4. For vehicle classification: 95% (no more than +/- 5% error in classification calculation)
5. For presence detection: 95% (no more than +/- 5% missed actuations)

D. Testing

Vendors are required to submit an independent test evaluation report from a third party which verifies the accuracies stated within their specifications.

Independent third-party verification (ITPV) is defined as the evaluation of the conceptual, functional, and technical requirements of a product being reviewed by one or more independent third parties qualified by their education, training, and experience in the same discipline, to judge the worthiness of the products' likelihood of achieving the intended objectives and anticipated outcomes.

Develop and submit plans for pre-installation and post-installation testing to the Engineer for consideration and approval. Ensure the plans test all functional requirements outlined in Section 937.2.02B and the accuracy requirements stipulated in Section 937.2.02C. Provide the Engineer with Application Protocol Interface (API) documentation and Software Development Kit (SDK) for the video detection system.

1. Pre-installation test requirements: Include at a minimum the following procedures in the test plan to demonstrate the Microwave Detection System provides all the functional requirements in Section 937.2.02B and meets the accuracy requirement stipulated in Section 937.2.02C. Installation of detection systems will not begin until the pre-installation test requirements have been successfully completed.
 - a. Install a test microwave detection system at a location determined by GDOT. Install a new microwave detector for the test. Install a test video detection system that includes all components of the system including a microwave detector, microwave detector processor and software.
 - b. Connect the Microwave Detection System processor to the GDOT communications network via a GDOT-provided field switch. Assign an IP address to the processor per GDOT's direction.
 - c. From the nearest hub building, configure the Microwave Detection System processor to gather the data required in Section 937.2.02B.9. Verify that the configuration data is stored in non-volatile memory. Initial configuration of the detection system shall be done with a programming device that is either a

keyboard/keypad or stationary track ball pointing devices. Connect the programming device to the front of the processor module through a USB, DB9 or PS/2 connector. Provide a programming device that is PC compatible.

- d. Demonstrate each required data element is gathered by the system at the user-specified interval. Use 20-seconds as the interval for this phase of testing.

Prove the accuracy of the detection system meets requirements in Section 937.2.02C by:

- 1) Driving a vehicle of known speed through the detection zone and observing and recording the speed calculated by the system. Repeat this measurement at least five times.
 - 2) Perform the above accuracy tests in both rainy and dry conditions.
 - 3) Upon GDOT acceptance of pre installation test results, begin the installation of microwave detection system as specified in the plans.
 - 4) If any part of the pre installation test fails, the contractor has up to two subsequent attempts to correct the problem to the satisfaction of the Engineer. All these subsequent tests must be completed within a two week period from the date of initial failure.
2. Post-installation test procedures: Utilize the following test procedures after the microwave detection system has been installed in its entirety as shown on the Plans. Commence no post-installation testing until all microwave detection systems in the project have been configured/calibrated to gather speed, volume, classification, and occupancy and programmed to communicate on the GDOT network. At this stage of testing, GDOT will be required to have in place the necessary interfaces to the Microwave Detection System.
 - a. Inspect all microwave detection system field components to ensure proper installation and cable termination.
 - b. Verify that field construction has been completed as specified in the plans.
 - c. Inspect the quality and tightness of ground and surge protector connections.
 - d. Check power supply voltage and outputs and ensure device connections are as specified in the Plans.
 - e. Verify that the installation of cables and connections between all detectors and field cabinets are as specified in the Plans
 - f. Demonstrate that each Microwave Detection System is fully operational and gathering the required data types at the specified interval. Perform this test from the hub building through which the detection system is connected.
 - g. Upon satisfactory completion of step f, GDOT will add the new microwave detection system(s) into the central NaviGator system
 - h. Begin a 30-day burn test and ensure the system remains fully operational during the 30 day period as stipulated in Section 647.3.06.C.

937.2.03 Intersection Video Detection (I-VDS)

A. Technical Requirements

I. Video Camera Sensor

Send a video signal from the video camera sensor to the processor, using high resolution, video camera sensors as the primary video source for real-time vehicle detection. Use optical filters and/or electronic circuitry in the video camera sensor to compensate for blooming at night caused by headlights and minor vibration caused by wind. Include a heater at the front of the enclosure to prevent the formation of ice and condensation in cold weather. Ensure that the heater does not interfere with the operation of the video camera sensor electronics, or cause interference with the video signal, where applicable. As a minimum, meet the following requirements for each video camera sensor assembly installation:

- a. Use a 1/4" to 1" interline or frame transfer charge coupled device (CCD). Do not use complimentary metal-oxide semiconductor (CMOS) image sensors.
- b. Use Active pixel elements that are 768 Horizontal, 494 Vertical (minimum)
- c. The video standard should be compliant with NTSC Standard, RS-170A Compliant (available as EIA-170A specification)
- d. Use an 8-48 mm variable focal length lens that is adjustable from outside the camera enclosure, where applicable. Provide an Electric Lens Adjustment Device and associated wiring to adjust the variable focal length lens
- e. A resolution of 380 Horizontal TVL, 350 Vertical TVL minimum is required.
- f. Ensure the Automatic gain control (AGC) is a 20 dB minimum. Do not allow AGC to be applied until the automatic iris control has fully opened the aperture
- g. For Electromagnetic interference, ensure compliance with FCC Part 15, Subpart J, Class A device requirements, which apply to the video camera sensor and associated connected equipment in their installed condition
- h. Power the video camera sensors with 115 VAC \pm 10%, 60 Hz nominal \pm 3 Hz. Size the power conductors from the power source to the camera input so that no more than a 3% voltage drop is experienced (NEC 210-19 a., FPN No. 4). Include a provision at the rear of the camera enclosure for a waterproof connection of power and video signal cables. Provide power from the cabinet power source through a surge suppressor and then to the video camera sensor.
- i. The Video camera sensor enclosure shall be installed in a light colored enclosure to limit solar heating. Meet NEMA 250 Type 4 enclosure standards for the enclosure and seal the enclosure to prevent sand, dirt, dust, salt and water from entering. Affix a sun shield visor to the front of the enclosure which is sufficiently adjustable to divert water away from the video camera sensor lens and also prevent direct sunlight from entering the iris when mounted in its installed location.
- j. Provide outdoor-rated power, coaxial video, and lens adjustment (where applicable) wiring from the sensor enclosure to the cabinet in accordance with the manufacturer's recommendations. However, if the sensor junction box is used, seal the wiring connection at the housing from water or dust entry into the housing. For the standard video camera sensor mounting as shown in the details, provide approximately 4 ft (1.22 m) long wiring to enter the bottom of the junction box and terminate inside. Provide a male BNC connector with gold-plated body and center pin at the junction box end of the coaxial video cable. When providing a lens adjustment harness, ensure that the connector on the harness properly mates to the lens adjustment control unit.
- k. The maximum weight of the video camera sensor shall be 10 lbs (4.5 kg) (maximum with mount, shield, and camera).
- l. Ensure the size of the video camera sensor is (HxWxL): 5" x 5" x 18" [130 mm x 130 mm x 460 mm] (maximum, including camera enclosure)

2. Programming Monitor, Type A

As a minimum, provide a 9" high resolution video monitor with a minimum of 750 TVL, (1) input, (1) output BNC connection, IVp-p, input impedance high (loop through) 75 ohms terminated. Provide 6-ft factory manufactured high flex coaxial video cables with BNC connectors with each programming monitor. If more than one video input is received provide the ability to monitor all inputs on the monitor by using a video selector switching device.

3. Programming Device

Configure the detection system with a Programming Device that is either a keyboard/keypad or stationary track ball pointing device. Connect the Programming Device to the front of the processor module through a USB, DB9, PS/2 connector. Provide a Programming Device that is PC compatible.

4. Processor Module

Provide a processor module, which performs video image processing, that completely fits within the loop detector slots of the traffic signal/ramp meter controller cabinet input file and that provides a standard relay closure detector input to the controller. Provide four detector outputs through the processor module which communicate through the edge card connector. Use a module that is not wider than two standard input file slots. Include detection indicators on the front panel of the processor module for each of the four channels of detection provided through that module to indicate detector output in real time when the system is operational. Include a BNC connector with gold plated center pin or an RCA jack on the front panel for video output to the Programming Monitor, and include a USB, DB9 or PS/2 connector on the front panel to connect the Programming Device. Send the video signal over coaxial cable from the video camera sensor to the Processor Module using one of the two following methods:

- a. Connect the coaxial cable from the video camera sensor to the surge suppressor and from the surge suppressor connect the coaxial jumper cable with a 90 degree elbow gold-plated BNC connector to BNC connector on the front panel of the Processor Module; or
- b. Connect the coaxial cable from the video camera sensor to the surge suppressor and connect the coaxial jumper cable from the surge suppressor to the loop detector panel using a spade lug connection such that the video signal communicates from the loop detector panel to the Processor Module through the cabinet input file.

Provide power to the processor modules through the input file. The processor modules are defined as follows:

- Processor Module, Type A - provide one (1) video camera sensor input
- Processor Module, Type B – provide two (2) video camera sensor inputs
- Processor Module, Type C – provide four (4) video camera sensor inputs

5. Output Expansion Modules, Types A and B

Provide detector outputs, in addition to detector outputs provided through the processor module, through an output expansion module that mounts in the traffic signal/ramp meter controller cabinet input file and that provides a standard relay closure detector input to the controller. Provide 2 outputs through the edge card connector of each module. Connect the expansion module to the processor module with a cable that has standard modular connectors. Use a module that is not wider than 1 detector card per two additional detector outputs or that is not wider than 2 detector cards per four additional detector outputs. Include detection indicators on the front panel of the output expansion module for each channel of detection provided through that module to indicate detector output in real time when the system is operational.

The Type B output expansion module provides 4 outputs through the edge card connector of each module. The procedure for connecting the expansion module to the processor module is the same as shown above.

Provide power to the expansion module through the input file.

6. Environmental

a. Video Detection System Processor

Provide a video detection system processor that operates reliably in a typical roadside traffic cabinet environment. Provide internal cabinet equipment and a video detection system processor that meet the environmental requirements of NEMA TS1-1989 (R1994, R2000, R2005).

b. Video Camera Sensor

- 1) Provide video camera sensors that operate reliably in a roadside environment. Provide video camera sensors that meet the environmental requirements of NEMA TS1-1989 (R1994, R2000, R2005), Section 2.1.5.2. Provide video camera sensors that operate from -31 °F to 120 °F (-35 °C to +50 °C) from 5% to 95% relative humidity. An operating ambient temperature range from -30°F to 140°F (-34°C to 60°C) is required. Additionally, include a heater to prevent the formation of ice and condensation in cold weather. Do not allow the heater to interfere with the operation of the video camera sensor electronics, or cause interference with the video signal.

- 2) **Vibration:** Ensure that vibration does not impair performance when the camera is mounted on 50' (15 m) or shorter pole. Do not allow vibration to impair performance when the camera is mounted on 96 ft (29 m) or shorter pole. Provide a video camera sensor and enclosure that maintains its functional capability and physical integrity when subjected to a vibration of 5 to 30 Hz up to 0.5 gravity applied to each of three mutually perpendicular axes (NEMA TS1-1989(R1994, R2000, R2005), Section 2.1.12).
 - 3) **Processor and Expansion Modules:** Provide processor and expansion modules that operate reliably in a typical roadside traffic cabinet environment. Provide equipment that meets the environmental requirements of NEMA TS1-1989 (R1994, R2000, R2005) and NEMA TS2-2003 standards and the environmental requirements for Type 170 controllers. Provide equipment that operates from -29 °F to 140 °F (-34 °C to +60 °C) from 0% to 95% relative humidity, non-condensing.
 - 4) **Shock:** Ensure the video camera sensor & enclosure can withstand a 10G±1G shock. Neither permanent physical deformation nor inoperability of the video camera sensor and enclosure can be sustained as a result from this shock level.
 - 5) **Acoustic Noise:** Provide a video camera sensor and enclosure that can withstand 150 dB for 30 minutes continuously, with no reduction in function or accuracy.
7. **Electrical and Power Requirements**

a. **Video Detection System Processor**

Power the video detection system processor by 120 VAC, 60 Hz, single phase, and draw a maximum of 1.0 A. Size power conductors from the power source for the video detection system processor input so that no more than a 3% voltage drop is experienced (NEC 210-19 a., FPN No. 4). The video detection system processor shall have transient protection that meets the requirements of NEMA TS1-1989 (R1994, R2000, R2005) and NEMA TS2-2003 standards. Power to the video detection system processor shall be from the card rack.

b. **Video Camera Sensor**

Use a video camera sensor that is compatible with the video detection system processor and meets the following input power requirements: 115 VAC, 60 Hz. The I-VDS PDA shall obtain power from the 15 amp equipment breaker in the traffic signal/ramp metering cabinet PDA panel. Size power conductors from the power source to the camera input so that no more than a 3% voltage drop is experienced (NEC 210-19 a., FPN No. 4). Include a provision at the rear of the camera enclosure for the waterproofing of the connection of power and video signal cables.

8. **Documentation**

Provide the following documentation in the documentation pouch of each traffic signal/ramp meter cabinet:

- One operation manual with programming instructions
- One maintenance manual with schematics
- Three legible wiring prints showing all I-VDS components and connections with the cabinet

B. Functional Requirements for I-VDS

1. **General Requirements**

In order to be approved for use in GDOT projects, Intersection Video Detection Systems (I-VDS) must be able to provide certain data elements at or better than a minimal defined accuracy level. This section defines the minimally required functional aspects of the system as well as the required accuracy levels. It also outlines the testing process that will be used to determine whether a proposed video detection system product meets these specifications.

- a. Ensure that I-VDS detect vehicle presence and passage, speeds, vehicle counts, classification, and roadway occupancies on a lane-by-lane basis. Verify that the system can emulate the output of a pair

of 6 ft. by 6 ft. in-pavement loops spaced 16 ft. apart. Ensure the I-VDS are capable of providing the above data for 24 detection zones with one video camera sensor. Verify that the system responds with the accumulated traffic data as collected since the last request.

- b. Verify that the traffic data collected by the I-VDS is stored within internal non-volatile memory. Verify that data can be retrieved from the system locally. The port connector shall be on the front of the detection system processor for easy access. Ensure that the detection system processor software is stored in non-volatile memory within the video detection system processor. Perform software updates through a serial, Ethernet, or USB port.
- c. Ensure the system user can use a laptop to reprogram, calibrate, adjust or alter any previously defined detector configurations. Ensure no periodic adjustments or fine-tuning is required except in the case of physical roadway changes such as lane-shifts, new construction or closures. Initial configuration of the detection system shall be done with a programming device that is either a keyboard/keypad or stationary track ball pointing devices. Connect the programming device to the front of the processor module through a USB, DB9 or PS/2 connector. Provide a programming device that is PC compatible.
- d. The detection system processor front panel shall include a visual display of the status of each video input and the status of the video detection system processor in general. Indicators shall display, at a minimum, the status of the processor the status of communications, and whether or not each video camera sensor is actively detecting.

2. System Hardware: Provide a detection system that does not require any equipment external to the traffic signal/ramp meter controller cabinet input file (excluding the video camera sensor, video camera sensor power connection, circuit breakers and surge suppression for video or data). Mount the processor and expansion modules in the traffic signal/ramp meter controller cabinet input files, using the edge card connector to obtain power and provide contact closure outputs. Rewiring of the backplane or any other cabinet panel for the system is not permitted except for power and grounding for the interface panel, wiring from the video camera sensor to the loop detector panel for the video signal and wiring to obtain power for the video camera sensor.

Provide a system capable of providing a minimum of eight detector outputs per video camera sensor. Provide all detector outputs through edge card connectors of the processor module and output expansion module(s). Rewiring external to the edge connectors is not permitted for obtaining a minimum of eight outputs for one video camera sensor.

3. System Software System Processing Software: On the processor module that mounts in the traffic signal/ramp meter controller cabinet input file, include the software that processes the video camera sensor signals and converts the signals into detector outputs. Detect either approaching or receding vehicles in multiple lanes within the field of view (FOV) of each video camera sensor. Provide the capability of detecting vehicles in up to 24 detection zones per video camera sensor with the detection system. Allow the detection zones to be combined to form an output using the AND, OR and NOT logical functions.

- a. Detection Compensation: Provide the capability for the processor to compensate for camera movement attributable to temperature effects, wind shifting, pole sway, pole expansion, or vibration.
- b. System Configuration Software: On the processor module, include the configuration software to program the detection system, including the detection zones. Perform programming by accessing the software through a Programming Monitor and a Programming Device.

4. Programming Requirements

Employ menus for the Configuration Software. Provide the capability through the Configuration Software for the user to define detection zones through interactive graphics by placing lines and/or boxes in an image on a Programming Monitor. Provide the capability for the user to redefine previously defined detection zones.

5. Detection Zone Placement and Manipulation:

Allow up to 24 detector zones to be defined through the software for each video camera sensor. Provide the capability to place vehicle detection zones anywhere within the field of view of the video camera sensors through the Configuration Software. Use detection zones that are lines or boxes drawn in each visible lane or area of desired

detection. Provide the capability to use one detection zone to replace multiple inductive loop detectors. Detection zones may overlap if necessary. Provide the ability for the user to assign logical functions such as AND, OR and NOT to one detector or a group of detectors.

On the Programming Monitor, display the detection zones superimposed on the video camera sensor's images. Provide the capability to create detection zones of varying size and shape to allow best coverage of the viewable roadway lanes and ramps. Provide the capability to save the detection zone format on the processor module card once drawn for a particular video camera sensor image. Provide the capability for the user to view the currently active detector zone format of the processor module via a Programming Monitor.

- a. Detection Zone Editing: Provide the capability to edit existing detector configurations using a Programming Monitor with the Programming Device used to perform the programming functions.
- b. Confirmation: When viewing vehicle actuations in real time on the Programming Monitor, indicate the passage or presence of each vehicle detected by each detection zone by changing the color or intensity of that particular zone.
- c. Detection During Reconfiguration: Provide the capability for the detection system to continue detecting vehicles on all existing zones during reconfiguration, except on the zone that is being reconfigured.
- d. I-VDSn: I-VDSn refers to all of the specific I-VDS components necessary for operation and detection on one approach leg of an intersection. The "n" denotes the approach's through-movement controller phase in the nomenclature of a typical 8-phase dual-ring intersection operation (e.g., I-VDS2, I-VDS4, I-VDS6, I-VDS8) when four video camera sensors are installed. If more than four video camera sensors are installed, the "n" denotes the controller phase being detected in the nomenclature of a typical 8-phase dual ring intersection operation. I-VDSn is also used as a prefix to identify the individual I-VDS components of the "n" approach as follows:
 - I-VDSnVCS: the video camera sensor for approach "n"
 - I-VDSnCC: the coaxial cable from the video camera to the controller cabinet for approach "n"
 - I-VDSnPC: the video camera sensor power cable from the video camera to the controller cabinet for approach "n"
 - I-VDSnCSS: the coaxial cable surge suppressor in the controller cabinet for approach "n"
 - I-VDSnCJ: the coaxial jumper cable from the coaxial surge suppressor in the controller cabinet to the processor module or detector panel for approach "n"
 - I-VDSnPM: the processor module for approach "n", where a Processor Module, Type A is installed
 - I-VDSpn/snPM: the processor module for approach "pn" and "sn", where "pn" is the primary approach and "sn" is the secondary approach, where a Processor Module, Type B is installed.
 - Occupancy: individual lane occupancy measured in percent of time
- e. Ramp Meter Controller Cabinet Input File: A Ramp Meter Controller Cabinet Input File is a chassis within a traffic signal cabinet rack that has slots where a detector card provides detector output to the traffic signal controller through its edge card connectors. The backplane connector pin output of the edge connectors conforms to Georgia traffic signal controller cabinet standards for the cabinet type specified in the plans.
- f. I-VDSnnn: I-VDSnnn refers to all of the specific I-VDS components necessary for operation and detection related to ramp metering installations based on direction, type of detection and lane assignments. The first "n" denotes the approach direction (north, south, east or west) and the second "n" denotes the type of detection, P=Passage Detection Zones, D=Demand Detection Zones, Q=Queuing Detection Zones, ML=Mainline Detection Zones, the third "n" denotes the lane assignment (lane 1=L01, lane 2=L02, lane=L03, lane=L04), the (e.g., I-VDSnPL01, I-VDSsDL02, I-VDSQL03, I-VDSwMLAL04). The typical ramp metering layout is shown below:

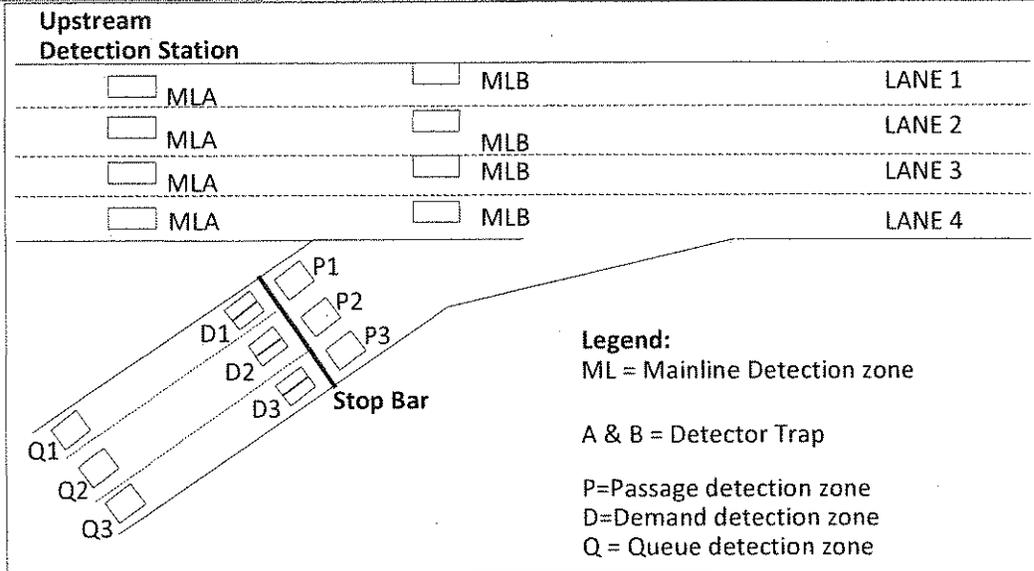


Figure 1: Typical Ramp Meter Layout

Lane numbering shall begin at the median for mainline travel lanes. Lane numbering for ramp meter lanes shall begin with the lane adjacent to the mainline travel lanes,

I-VDS is also used as a prefix to identify the individual I-VDS components as follows:

- I-VDS_{nnn}VCS: the video camera sensor for “nnn” direction, type of detection and lane assignment
- I-VDS_{nnn}CC: the coaxial cable from the video camera to the controller cabinet for approach “nnn” direction, type of detection and lane assignment
- I-VDS_{nnn}PC: the video camera sensor power cable from the video camera to the controller cabinet for approach “nnn” direction, type of detection and lane assignment
- I-VDS_{nnn}CSS: the coaxial cable surge suppressor in the controller cabinet for approach “nnn” direction, type of detection and lane assignment
- I-VDS_{nnn}CJ: the coaxial jumper cable from the coaxial surge suppressor in the controller cabinet to the processor module or detector panel for approach “nnn” direction, type of detection and lane assignment
- I-VDS_{nnn}PM: the processor module for approach “nnn” direction , type of detection and lane assignment

C. Accuracy Requirements for I-VDS

Provide I-VDS that meet the minimum accuracy requirements for both daytime and night time conditions:

1. For volume (vehicle counts): 95% (no more than 5% missed actuations).
2. For speed measurement: 95% (no more than +/- 5% error in speed calculation)
3. For occupancy measurement: 95% (no more than +/- 5% error in occupancy calculation)
4. For presence detection: 96% (no more than +/- 4% missed actuations)
5. For passage detection: 95% (no more than +/- 5% missed actuations)

D. Testing

Vendors are required to submit an independent test evaluation report from a third party which verifies the accuracies stated within their specifications.

Independent third-party verification (ITPV) is defined as the evaluation of the conceptual, functional, and technical requirements of a product being reviewed by one or more independent third parties qualified by their education, training, and experience in the same discipline, to judge the worthiness of the products' likelihood of achieving the intended objectives and anticipated outcomes.

Develop and submit plans for pre-installation and post-installation testing to the Engineer for consideration and approval. Ensure the plans test all functional requirements outlined in Section 937.2.03B and the accuracy requirements stipulated in Section 937.2.03C. Provide the Engineer with Application Protocol Interface (API) documentation and Software Development Kit (SDK) for the video detection system.

1. Pre-installation test requirements: Include at a minimum the following procedures in the test plan to demonstrate the I-VDS provides all the functional requirements in Section 937.2.03B and meets the accuracy requirement stipulated in Section 937.2.03C. Install no detection systems specified in the Plans until the pre-installation testing has been successfully completed.
 - a. Install a test video detection system at a location determined by GDOT. Install a new video sensor for the test. Install a test detection system that includes all components of the system including a video sensor, a video detection processor and software.
 - b. Configure the test system with at least 24 detection zones, including presence, passage, volume, speed, and occupancy.
 - c. Demonstrate that each required data element is gathered by the system at the user-specified interval. Prove the accuracy of the detection system meets requirements in Section 937.2.03C by:
 - 1) Driving a vehicle of known speed and length through the detection zone and observing and recording the speed and length calculated by the system. Repeat this measurement at least ten times.
 - 2) Drive a vehicle into a presence detection zone and ensure the system recognizes the presence of the vehicle.
 - 3) Drive a vehicle into a passage detection zone and ensure the system recognizes the passage of the vehicle.
 - 4) Perform the above accuracy tests in both night and day conditions.
 - 5) Upon GDOT acceptance of pre installation test results, begin the installation of I-VDS as specified in the plans
 - 6) If any part of the pre installation test fails, the contractor has up to two subsequent attempts to correct the problem to the satisfaction of the Engineer. All subsequent attempts must be completed within two weeks of the initial failure.
2. Post-installation test procedures: Utilize the following test procedures after the detection system has been installed in its entirety as shown on the Plans and as required by manufacturers' recommendations. Commence no post-installation testing until all video detection systems in the project have been configured/calibrated with the detection zones as shown in the plans.
 - a. Inspect all I-VDS field components to ensure proper installation and cable termination.
 - b. Verify that field construction has been completed as specified in the plans.
 - c. Inspect the installation of grounding and the surge protection systems.
 - d. Check power supply voltage and outputs and ensure device connections are as specified in the Plans.

- e. Verify that the installation of cables and connections between all detectors and field cabinets are as specified in the Plans
- f. Demonstrate each I-VDS is fully operational and gathering the required data types for each detection zone.
- g. Begin a 30-day burn test and ensure the system remains fully operational during the 30 day period as stipulated in Section 647.3.06.C.

937.3 Construction/Installation Requirements

937.3.01 Quality Control

A. Training

Provide a minimum of at least eight (8) hours of configuration and maintenance training. The persons to be trained will be determined by the Engineer. Configuration training should last a minimum of three (3) hours and must include instructions for programming, hands on training in programming detection zones, adjusting, and calibrating the detection system. One hands on unit shall be provided per attendee during training. Maintenance training should last a minimum of five (5) hours and must include instructions on troubleshooting, maintenance, and operation for all detection system components. Each class will have a maximum of eight (8) people. The contractor must provide a training notebook to each trainee and an electronic copy of the training notebook to the Engineer.

The contractor must provide a location for holding the courses and pay all costs associated with travel and accommodation of the trainees if training is conducted away from the project area.

Notify the Engineer 20 days before training and agree on a time and place to conduct the training. If agreement cannot be reached, the Engineer will determine the time

B. Warranty

Provide complete detection system equipment and software with a minimum (2) year warranty which begins once GDOT has provided notification that all devices have successfully passed the 30-day burn.

When the Department detects a failure of any component of the system during the warranty period, the Department will notify the Contractor, Distributor, and/or Manufacturer in writing of the problem.

Correct the problem within seven calendar days after receiving the notification or else pay liquidated damages in the amount of \$600 per calendar day until the problem is corrected. Repair or replace the defective device(s) and ensure that all vehicle detection affected by the problem is brought within original accuracy parameters. The problem will be considered resolved when the Department has verified accuracy.

Ensure the Manufacturer/Contractor/Distributor will repair any faulty equipment during this period at no cost to the Department for parts, labor, or shipping to and from the factory.

Both a hardcopy and electronic copy of the warranty, including its date of inception and contact information for a manufacturer representative must be provided to the Engineer.

C. Support

During the warranty period, supply any firmware or software upgrades associated with the detection system to the Department at no charge. In addition, provide phone consultation as needed at no cost during the warranty period for operating questions or problems that arise.

If the Department desires, it may enter into a separate agreement with the suppliers for technical support and software upgrades. Make available such a program to the Department after the original warranty period.

937.3.02 Video Detection System Installation Requirements**A. General Installation Requirements:**

Install all video camera sensors, video detection system processors, and associated enclosures and equipment at the locations specified in the Plans. Install all rack-mounted equipment with one rack unit space between adjacent equipment.

Installation must comply with manufacturer's recommendation. All equipment, cables, and hardware must be part of an engineered system that is designed by the manufacturer to fully interoperate with all other system components. Connectors installed outside the cabinets and enclosures must be corrosion resistant, weather proof, and watertight. Exposed cables must be UV and weather resistant. Label cables with permanent cable labels at each end.

Install VPU with a Model 2070 controller assembly. Install VDS power supply or transformer on a standard DIN rail using standard mounting hardware and power conductors wired to terminal blocks in the controller cabinet.

Wire each VDS sensor assembly to the controller cabinet with a wiring harness that includes all power, control wiring, and coaxial video cable. Attach harness with standard Mil spec type and rated plugs. Cable type and wire characteristics must comply with manufacturer's recommendations for the VDS to cabinet distance for the project.

Wiring and cables must be continuous (without splices) between the VDS sensor and controller cabinet. Coil a minimum of 2 (.61m) feet of slack in the bottom of the controller cabinet. For setup and diagnostic access, terminate serial data communication output conductors at TB-0. Tape ends of unused and spare conductors to prevent accidental contact to other circuits. Label conductors inside the cabinet for the functions depicted in the approved detailed diagrams.

Furnish an as-built cabinet-wiring diagram, identified by location, for each VDS cabinet. Include all wiring, cabling, connections, and camera mounting height. Place all documentation in a weatherproof holder in the cabinet.

1. Camera Sensor Operating Locations

Adjust the video camera sensor lens to match the width of the road and minimize vehicle occlusion. Mount the camera on the specified pole or structure for that location as shown on the plans.

2. Cabinet Types

- Type A Cabinet – The Type A cabinet housing is a standard Model 336 stretch (336S) housing with approximate exterior dimensions of 46 in. (1.2 m) (H) x 24 in. (0.61 m) (W) x 23 in. (0.58 m) (D).
- Type B Cabinet - The Type B cabinet housing is a standard Model 337 housing with approximate exterior dimensions of 35 in. (0.89 m) (H) x 20 in. (0.5 m) (W) x 17 in. (0.43 m) (D).
- Type C Cabinet - The Type C cabinet housing is a standard Model 332 housing with approximate exterior dimensions of 64 in. (1.6 m) (H) x 24 in. (0.61 m) (W) x 30 in. (0.76 m) (D).
- Type D Cabinet – The Type D cabinet housing is a standard Model 336 stretch (336S) housing with approximate exterior dimensions of 46 in. (1.2 m) (H) x 24 in. (0.61 m) (W) x 23 in. (0.58 m) (D). The difference between a Type D and Type A cabinet is the difference in interior cabinet configuration as shown in the Detail Drawings in this section.
- Type F Cabinet - The Type F cabinet housing shall be a standard ITS Cabinet Housing #3 with approximate exterior dimensions of 67 in. (1.7 m) (H) x 44 in. (1.2 m) (W) x 26 in. (0.66 m) (D).

The cabinet type to be used will be shown in the plans.

3. Cabinet Equipment

- a. Wiring, Conductors and Terminal Blocks: Use stranded copper for all conductors, including those in jacketed cables, except for earth ground conductors, which may be solid copper. Neatly arrange all wiring, firmly lace or bundle it, and mechanically secure the wiring without the use of adhesive fasteners. Route and secure all wiring and cabling to avoid sharp edges and to avoid conflicts with

other equipment or cabling. Route camera control wiring, and 120 VAC power wiring separately. Terminate all wiring on a terminal block, strip, bussbar, or device clamp or lug; do not splice any wiring. Use a minimum #12 AWG for all conductors of 120 VAC circuits.

Label coaxial cables for VDS cameras between SS1 -SS22 and the VDS video input "CX" where the "X" indicates the surge suppressor identifier (e.g., cable C9 connected to SS17, cable C10 connected to SS18.)

Number all terminal blocks, terminal strips, circuit breakers and bussbar breakers and have each item and each terminal position numbered and named according to function as shown in the "quoted labels" in the Detail Drawings. Label terminal blocks, terminal strips, circuit breakers and bussbars with silk screened lettering on the mounting panel.

- b. Surge Suppression: Protect all copper wiring and cabling entering the cabinet housing, except for the earth ground conductor, by surge suppression devices as specified. Terminate all wiring between cabinet devices and the transient surge suppressors, except for the video signal coaxial feed, on terminal strips. Use a minimum #16 AWG grounding of each surge suppression device, or larger if recommended by the surge suppression device manufacturer. Use insulated green wire and connect the ground wire directly to the ground bussbar. Do not "daisy chain" with the grounding wires of other devices including other surge suppressors. Dress and route grounding wires separately from all other cabinet wiring. Install grounding wires with the absolute minimum length possible between the suppressor and the ground bussbar. Label all surge suppressors with silk-screened lettering on the mounting panel.

Use minimum #18 AWG insulated black wiring between the surge suppression device sockets and the terminal blocks for the protected circuits.

Furnish and install a surge suppressor (SS17 through SS22 as required) for each video signal coaxial line. For each cabinet housing, include surge suppressor SS16 for the VDS camera power lines installed on TB2.

- c. Component Installation: Fasten all components of the cabinet assembly to be mounted on cabinet side panels with hex-head or phillips-head machine screws. Install the screws into tapped and threaded holes in the panels. These components include but are not limited to terminal blocks, bussbars, panel and socket mounted surge suppressors, accessory and equipment outlets, and DC power supply chassis. Fasten all other cabinet components with hex-head or phillips-head machine screws insulated with nuts (with locking washer or insert) or into tapped and threaded holes. All fastener heads and nuts (when used) shall be fully accessible within a complete cabinet assembly, and any component shall be removable without requiring removal of other components, panels, or mounting rails. Do not use self-tapping or self-threading fasteners.
- d. Mounting Bracket Assembly: Mount the video camera sensor on a mounting bracket assembly as shown in the details such that its height and position provide a clear view of the approach or lanes in ramp metering operations. Mount the video camera sensor securely such that it is stable and steady. The mounting bracket assembly includes a video camera sensor mounting bracket, nipple pipe, cable-mount nipple clamp, and all associated hardware and materials. Mount the video camera sensor on a mounting bracket assembly which meets the following requirements unless otherwise specified in the plans:
- 1) Use stainless steel fastening hardware with lock washers on threaded fasteners
 - 2) Use a video camera sensor enclosure mounting bracket that is non-rusting and is made from die cast aluminum, extruded aluminum, powder-coated galvanized steel or hot dipped galvanized steel. Provide a mounting bracket that permits vertical and horizontal adjustment of the video camera sensor. Provide a mounting bracket that securely fastens to the video camera sensor enclosure and mounts to the nipple pipe by threading onto the pipe or as a slip-fit, using a set-screw fastener in either above method.
 - 3) Use a 1 ½" (38 mm) aluminum nipple pipe that is threaded on both ends.

- 4) Fasten the nipple pipe to the mast arm using a cable mount nipple clamp with minimum 2 5/16" (58 mm) U bolts. Use aircraft grade galvanized steel cables with stainless steel fastening hardware and that make at least two wraps around the mast arm. Do not use banding straps.
- e. Video camera sensor junction box: If approved for use, provide a wiring junction box with mounting hardware for termination/connection of the sensor housing wiring with the field cabling from the traffic signal/ramp meter controller cabinet as shown in the details. Provide a cast aluminum or 0.125" (3.175 mm) sheet aluminum box with maximum inside dimensions of 8" H x 8" W x 4" D (200 mm H x 200 mm W x 100 mm D). Do not use steel- or plastic-bodied junction boxes. Provide a box that is NEMA 4 rated dust-tight, rain tight, and watertight and has a hinged and neoprene-gasketed door with stainless steel hinge pins and threaded fasteners for closing. Provide a 1 1/2" (38 mm) slip hole with rubber grommet with poke-through diaphragm for cable entry in the bottom of the box; no other holes in the box body shall be permitted except as required for the mounting U-bolts as shown in the details. Provide a 3-position fully-enclosed compact terminal strip rated for minimum 15 A current and #14 AWG conductors. Internal connectors shall be nickel-plated threaded fasteners for securing the conductors. The terminal strip shall be fully enclosed and covered with no exposed current-carrying metal surfaces. Label the three positions on the terminal strip as "AC+", "AC-", and "GR" with fastener secured or epoxy-cement permanent labels; do not use adhesive or self-stick labels. Provide a female-female BNC coupler with gold-plated body and center pin sockets, electrically isolated from the junction box by fastening to a non-conductive bracket mounted to the junction box side.
- f. Documentation: Provide the following documentation in the documentation pouch of each traffic signal/ramp meter cabinet:
- One operation manual with programming instructions
 - One maintenance manual with schematics
 - Three legible wiring prints showing all I-VDS components and connections with the cabinet
- g. Type D Cabinet Equipment

Install cabinet equipment as shown in Detail Drawing 937.1

h. Cables, Conduit, and Power Service

Furnish and install electrical cables used for video, control, communications signaling and power supply as shown in the Detail Drawings. Do not splice any cable, shield or conductor used for video, control, communications signaling, or power supply. Identify all conductors of all cables by color and number. Identify the conductor function in as-built documentation included in the cabinet documentation. Terminate cable used for video signaling in BNC connectors. After terminating and dressing the cables in the cabinet, neatly coil and store a minimum of 2 ft (.61 m) of cable slack in the bottom of the cabinet. Cut unused conductors to a length that can reach any appropriate terminal. Bend back unused conductors over their outer jackets and individually tape them.

Provide electrical cables for video, communications signaling and power supply between the cabinet and the device as required below and install them as shown in the Detail Drawings.

Beginning at individual video camera sensors, carry video signals from the camera to the pole-mounted junction/splice cabinet via coaxial cable to the video detection system processor located in the field cabinet. Transmit the vehicle traffic data from the video detection system processor to a traffic control center via the Ethernet network system.

Install cabling inside new hollow metal or concrete support poles unless otherwise specified. Use weather heads on all nipple and conduit openings. Neatly install and route cabling to minimize movement in the wind and chafing against the pole, device or bracket. Form a drip loop at the weather head and route cabling to minimize water entry into the cable connector. Use a 24" diameter drip loop where cables enter a weatherhead.

i. As-Built Drawings

Furnish an as-built cabinet wiring diagram, identified by location, for each VDS cabinet. Include all wiring, cabling, connections, and camera mounting height. Place all documentation in a weatherproof holder in the cabinet.

937.3.03 Microwave Detection System Installation Requirements**A. General Installation Requirements**

Install all detectors and associated equipment at the locations specified in the Plans. Installation must comply with manufacturer's recommendation. All equipment, cables, and hardware must be part of an engineered system that is designed by the manufacturer to fully interoperate with all other system components.

1. Detector

Install the microwave radar detector on poles as shown in the plans using supplied materials and brackets. Install the microwave radar detector to achieve the field of coverage shown in the Plans. Make field adjustments to the locations shown in the Plans only with the Engineer's approval. Set up the detection zones using a laptop computer and software provided by and the property of the Contractor.

2. Cabinet Equipment

- a. **Wiring, Conductors, and Terminal Blocks:** Use stranded copper for all conductors, including those in jacketed cables, except for earth ground conductors, which may be solid copper. Neatly arrange all wiring, firmly lace or bundle it, and mechanically secure the wiring without the use of adhesive fasteners. Route and secure all wiring and cabling to avoid sharp edges and to avoid conflicts with other equipment or cabling. Route microwave radar detector control wiring and 120VAC power wiring separately. Terminate all wiring on a terminal block, strip, bussbar, or device clamp or lug; do not splice any wiring. Use a minimum #12 AWG for all conductors of 120VAC circuits. Install all wiring as shown in the Detail Drawings.

Number all terminal blocks, terminal strips, circuit breakers and bussbar breakers and have each item and each terminal position numbered and named according to function as shown in the "quoted labels" in the Detail Drawings. Label terminal blocks, terminal strips, circuit breakers and bussbars with silk-screened lettering on the mounting panel.

- b. **Surge Suppression:** Protect all copper wiring and cabling entering the cabinet housing, except for the earth ground conductor, by surge suppression devices as specified. Terminate all wiring between cabinet devices and the transient surge suppressors and between the microwave radar detection unit and the surge protectors on terminal strips. Use a minimum #16 AWG grounding for each surge suppression device, or larger if recommended by the surge suppression device manufacturer. Use insulated green wire and connect the ground wire directly to the ground bussbar. Do not "daisy chain" with the grounding wires of other devices including other surge suppressors. Dress and route grounding wires separately from all other cabinet wiring. Install grounding wires with the absolute minimum length possible between the suppressor and the ground bussbar. Label all surge suppressors with silk-screened lettering on the mounting panel.

Use minimum #18 AWG insulated black wiring between the surge suppression device sockets and the terminal blocks for the protected circuits.

Furnish two (2) transient surge suppressors for the microwave radar detection units (SS24 and SS25).

- c. **Component Installation:** Fasten all components of the cabinet assembly to be mounted on cabinet side panels with hex-head or phillips-head machine screws. Install the screws into tapped and threaded holes in the panels. The components include but are not limited to terminal blocks, bussbars, panel and

socket mounted surge suppressors, Ethernet switches, circuit breakers, and accessory and equipment outlets. Fasten all other cabinet components with hex-head or phillips-head machine screws installed with nuts (with locking washer or insert) or into tapped and threaded holes. Fasten stud-mounted components to a mounting bracket providing complete access to the studs and mounting nuts. All fastener heads and nuts (when used) shall be fully accessible within a complete cabinet assembly, and any component shall be removable without requiring removal of other components, panels, or mounting rails. Do not use self-tapping or self-threading fasteners.

- d. As-Built Drawings: Furnish an as-built cabinet wiring diagram, identified by location, for each cabinet. Include all wiring, cabling, and connections. Place all documentation in a weatherproof holder in the cabinet.

3. Cables, Conduit and Power Service

Furnish and install electrical cables used for control, communications signaling and power supply as required below and as shown in the Detail Drawings. Do not splice any cable, shield or conductor used for control, communications signaling, or power supply. Identify all conductors of all cables by color and number. Identify the conductor function in as-built documentation included in the cabinet documentation. After termination and dressing the cables in the cabinet, neatly coil and store a minimum of 2 ft (.61m) of cable slack in the bottom of the cabinet. Cut unused conductors to a length that can reach any appropriate terminal. Bend back unused conductors over their outer jackets and individually tape them.

Install cabling inside new hollow metal or concrete support poles unless otherwise specified. Where devices are installed on existing wood poles, install cabling on the wood poles in rigid metal conduit risers of minimum 2 in (5.08 cm) diameter. Use weather heads on all nipple and conduit openings. Neatly install and route cabling to minimize movement in the wind and chafing against the pole, device or bracket. Form a drip loop at the weather head and route cabling to minimize water entry into the cable connector. Use a 24" diameter drip loop where cables enter a weatherhead.

4. As-Built Drawings

Furnish as-built drawings, including but not limited to microwave radar detection locations, microwave radar detection mounting heights, and component lists with brand, model and serial numbers. Place one copy of the as-built drawings in the cabinet documentation pouch and submit another copy to the Engineer.

937.3.04 Intersection Video Detection System Installation Requirements

A. General Installation Requirements

Install all video camera sensors, processor modules, output expansion modules, and associated equipment at the locations specified in the Plans. Mount the processor and output expansion modules within the traffic signal/ramp meter controller cabinet input files. No physical changes are permitted to the traffic signal/ramp meter controller cabinet input files. Make all necessary adjustments and modifications to the detection system prior to obtaining recommendation for system acceptance from the TMC and/or District Engineer. Installation must comply with manufacturer's recommendation.

Provide all programming equipment, documentation and incidentals needed for the installation, configuration and calibration of all detection system materials. This requirement includes but is not limited to equipment documentation, programming monitors, programming devices, and lens adjustment devices. Provide programming equipment during all installation and testing work.

All programming equipment shall be returned to the Engineer as a property of the State.

Perform all programming and configuration to all I-VDS and traffic signal controller and cabinet equipment for the full and complete operation of the detection system.

I. Video Camera Sensor

Install a video camera sensor with mounting bracket assembly as shown in the Plans or in accordance with the manufacturer's recommendations. Install the video camera sensor in the vertical and horizontal positions as

specified to provide the field of view and detection zones shown in the Plans. Make field adjustments to the positions specified in the Plans only with the Engineer's approval.

2. Programming Monitor

After all I-VDS programming is completed and accepted, deliver the programming monitor, associated materials such as the user manual and the packing container, and the video cables, to the Engineer at the project location or the Engineer's offices. Do not leave the monitor in the traffic signal/ramp meter cabinet.

3. Programming Device

After all I-VDS programming is completed and accepted, place the programming device with connector cord in a zipper- or snap-type re-sealable plastic bag in the cabinet documentation pouch.

4. Processor Module

Install the processor module in the cabinet input file and fully program and configure the module as shown in the Plans and in accordance with the manufacturer's recommendations. Ensure proper operation, including accurate detection, as programmed. Provide all equipment and materials necessary for programming and configuration, including a video display monitor.

5. Expansion Module

Install the expansion module in the cabinet input file and fully program and configure the module as shown in the Plans and in accordance with the manufacturer's recommendations. Ensure proper operation, including accurate detection, as programmed.

6. Field Cabling

Field cabling consists of separate video coaxial cable and the camera sensor power cable and/ or composite cable from the controller cabinet in accordance with manufacturer's recommendation. Field cable installation shall be continuous from the camera to the control cabinet. Do not splice any field cabling. Other methods may be approved by the Engineer.

Install the field cabling for each video camera sensor as shown in the Plans, or junction box if used, in accordance with the manufacturer's recommendations, and in accordance with the requirements for signal cable in Section 647 Traffic Signal Installation. Ensure that cable installation is complete from the video camera sensor junction box to the coax and power termination panels in the controller cabinet.

Label all field cabling within three inches of termination using clear overwrapping self-laminating cable labels and the appropriate cable label identification as defined in Section 937.3.03.A.7a-c and shown in the details. Label field cabling in the camera sensor, in the controller cabinet, and in all pull boxes and pole bases. After terminating and dressing the video camera sensor coaxial and power cables in the controller cabinet, neatly coil and store a minimum of 2ft (.61 m) of cable slack in the bottom of the cabinet. Provide a label for each cable for 2ft (.61 m) of cable slack.

Use a video coaxial field cable (labeled as "I-VDSnCC") that is double-shielded with tinned copper braid, #20 AWG solid copper center conductor, and polyethylene outer jacket approved for outdoor use. Terminate both ends of the coaxial cable per manufacturers requirements, if BNC connectors are used terminate with gold-plated body and center pin and as recommended by the cable manufacturer

Use a camera sensor power field cable (labeled as "I-VDSnPC") that is a 6-conductor cable with #16 AWG stranded copper conductors. Use a cable that is ozone and UV resistant, suitable for wet use, with a 600 V and 105 degree rating, is UL listed for indoor and outdoor use, and with 120 VAC standard black/white/green solid colored conductor insulation.

7. Cabinet Equipment

Install cabinet equipment as shown in the details and as required to provide the controller operation as shown on the Plans. Cabinet equipment shall include as a minimum an I-VDS power termination panel, an I-VDS coax termination panel, one or more coaxial cable surge suppressors, one or more coaxial jumper cables, power surge suppressor and all associated wiring and incidental materials.

General: Provide an I-VDS power and coax termination panel assembly and all associated materials in the controller cabinet for installation, including power distribution termination, power surge suppressor, video camera field cabling termination, video jumper cables, and surge protection in accordance with the manufacturer's recommendation.

Coaxial cable surge suppressors: Use either common-ground or balanced-differential video signal surge suppressors in accordance with the I-VDS manufacturer's recommendations. Use surge suppressors that have solid-state, hybrid clamping technology, and have equipment-side and field-side BNC connectors on the top of the suppressor enclosure as shown in the details.

Coaxial Jumper Cable: Use a video coaxial jumper cable (labeled as "I-VDSnJC") to connect the equipment (protected) terminal of the video signal surge suppressor directly to the processor module as applicable. Use a video coaxial jumper cable that is a high-flex cable or as recommended by the cable manufacturer, with double-shield tinned copper braid, #20-22 AWG stranded copper center conductor and polyethylene outer jacket. As applicable, terminate both ends or one end of the coaxial cable with BNC connectors with gold-plated body and center pin and as recommended by the cable manufacturer. Use coaxial jumper cables of the length necessary to route as shown in the details with no mechanical strain on the end connectors and no excess cable loops to be stored. Label coaxial jumper cables within three inches of end connectors using clear overwrapping self-laminating cable labels and the appropriate cable label identification ("I-VDSnJC") for the video camera sensor and processor module as shown in the Plans.

Exercise extreme caution when installing I-VDS equipment and materials at traffic signal/ramp meter installations. Repair any damage to existing traffic/ramp meter control equipment and materials which occurred during I-VDS installation to the Engineer's satisfaction at the Contractor's sole expense.

In 336S cabinets, locate the I-VDS power termination panel on the equipment rail in the lower left portion of the rear of the cabinet as shown in the details. Adjust the panel as far toward the cabinet sidewall as possible while still providing access to the circuit breaker. Notify the Engineer immediately if there is any conflict with existing cabinet equipment in this position. Ensure that there is no conflict with door-mounted components when the door is closed.

In 332 and 334 cabinets, locate the I-VDS coax termination panel in the lower open section of the front of the cabinet equipment rack as shown in the details. Notify the Engineer immediately if there is any conflict with existing cabinet equipment in this position. Ensure that there is no conflict with door-mounted components when the door is closed. Dress, label, and secure all coaxial cabling to and from the coax termination panel such that the panel can be hinged open a minimum of 90 degrees without binding or stressing any coaxial cable.

8. As-Built Drawings

Furnish as-built drawings, including but not limited to video camera sensor locations, video camera sensor mounting heights, details on the field cabling route through the intersection, and component lists with brand, model and serial numbers. Place one copy of the as-built drawings in the cabinet documentation pouch and submit another copy to the Engineer.

937.4 Measurement

937.4.01 Video Detection System

A. Video Camera Sensor Assembly

Video camera sensor assemblies paid for are the number actually installed, complete, functional, and accepted. Unless otherwise specified in the Plans, furnish and install the following minimum items for a video camera sensor assembly.

1. Camera, environmental enclosure, and mounting assembly with all associated hardware.

2. Cabinet equipment, including but not limited to wiring, conductors, terminal blocks, surge suppression, field switch and the sliding drawer.
3. All weather heads, vertical conduit risers, and conduit hardware on the VDS support pole for power service, grounding, communications, and control. If VDS and CCTV are mounted on the same pole, install common weather heads, conduit risers, and conduit hardware under Section 936 of the Specifications.
4. All hardware and materials necessary to provide electrical power service to the VDS field location as shown in the Plans, including but not limited to vertical sections of conduit, conduit hardware, wire, circuit breakers, disconnect closures, and grounding. The Department will pay for horizontal sections of conduit separately.
5. All cables, connectors, hardware, interfaces, supplies, and any other items necessary for the proper operation and function of any VDS system component to carry video signals to the video detection system processor.

B. Video Detection System Processor, Type A

Video detection system processors paid for are the number actually installed, complete, functional, and accepted. Unless otherwise specified in the Plans, furnish and install a video detection system processor to include, at a minimum, the following:

Video detection system processor equipment with two video inputs.

System software provided within the video detection system processor

C. Video Detection System Processor, Type B

Video detection system processors paid for are the number actually installed, complete, functional, and accepted. Unless otherwise specified in the Plans, furnish and install a video detection system processor to include, at a minimum, the following:

Video detection system processor equipment with four video inputs.

System software provided within the video detection system processor

D. Testing

Testing is measured as a lump sum for full delivery of testing and acceptance requirements.

E. Training

Training is measured as a lump sum for all supplies, equipment, materials, handouts, travel, and subsistence necessary to conduct the training.

937.4.02 Microwave Radar Detection

A. Microwave Radar Detector Assembly

Microwave radar detection assemblies paid for are the number actually installed, complete, functional, and accepted. Unless otherwise specified in the Plans, furnish and install the following minimum items for a microwave video detection assembly:

- Microwave radar detector
- Housing
- Field cabling and cabinet equipment
- Power supply
- Mounting bracket(s)
- All weatherheads, vertical conduit risers, and conduit hardware on the support pole for power and detector signal as shown in the plans

- Configuration

B. Testing

Testing is measured as a lump sum for full delivery of testing and acceptance requirements.

C. Training

Training is measured as a lump sum for all supplies, equipment, materials, handouts, travel, and subsistence necessary to conduct the training.

937.4.03 Intersection Video Detection System

A. Intersection Video Detection System Assembly

Intersection Video Detection System Assemblies paid for are the number actually installed, complete, functional, and accepted. Unless otherwise specified in the Plans, furnish and install the following minimum items for an Intersection Video Detection System Assembly:

1. Intersection Video Detection Assembly, Type A
 - a. Video Camera Sensor:
 - 1) Camera, environmental enclosure, variable focal length lens, mounting bracket assembly, with all associated hardware and incidental materials
 - 2) Electric Lens Adjustment Device; if more than one video camera sensor is installed at an intersection, provide one Electric Lens Adjustment Device for that intersection
 - 3) Field cabling and cabinet equipment, including but not limited to power and video cabling from the video camera sensor to the controller cabinet, processor module, power and coax termination panels, surge suppressor, cabinet wiring, and all associated hardware and incidental materials. If more than one Intersection Video Detection Assembly and/or video camera sensor is installed at an intersection or ramp meter installation, provide one power termination panel and one coax termination panel for that intersection or ramp meter installation.
 - 4) All weather heads, vertical conduit risers, and conduit hardware on the I-VDS support pole for power and video signal as shown in the Plans
 - b. Processor Module:
 - 1) Provide one Processor Module, Type A
 - 2) Configuration and processor software on the processor module
 - 3) Programming Device; if more than one Processor Module is installed in a cabinet at an intersection, provide one Programming Device for that cabinet
2. Intersection Video Detection Assembly, Type B
 - a. Video Camera Sensor:
 - 1) Provide two (2) cameras, environmental enclosures, variable focal length lenses, mounting bracket assemblies, and junction boxes with all associated hardware and incidental materials
 - 2) Electric Lens Adjustment Device; if more than one video camera sensor is installed at an intersection, provide one Electric Lens Adjustment Device for that intersection
 - 3) Field cabling and cabinet equipment, including but not limited to power and video cabling from the video camera sensors to the controller cabinet, processor modules, power and coax termination panels, surge suppressors, cabinet wiring, and all associated hardware and incidental materials. If more than one Intersection Video Detection Assembly and/or video camera sensor is installed at an intersection or ramp meter installation, provide one power

termination panel and one coax termination panel for that intersection or ramp meter installation.

- 4) All weather heads, vertical conduit risers, and conduit hardware on the I-VDS support pole for power and video signal as shown in the Plans

b. Processor Module:

- 1) Provide one Processor Module, Type B or C
- 2) Configuration and processor software on the processor module
- 3) Programming Device; if more than one Processor Module is installed in a cabinet at an intersection, provide one Programming Device for that cabinet

B. Output Expansion Module

Output expansion modules paid for are the number actually installed, complete, functional, and accepted. Unless otherwise specified in the Plans, furnish and install an Output Expansion Module to include, at a minimum, the following:

Output expansion module

Any cabling required to connect to the processor module or additional expansion modules

C. Programming Monitor

A Programming Monitor is measured for payment by the number actually furnished and accepted. Unless otherwise specified in the Plans, furnish a Programming Monitor to include, at a minimum, the following:

Programming Monitor

Any cabling required to connect the processing modules to the programming monitor

D. Testing

Testing is measured as a lump sum for full delivery of testing and acceptance requirements.

E. Training

Training is measured as a lump sum for all supplies, equipment, materials, handouts, travel, and subsistence necessary to conduct the training.

937.5 Payment

937.5.01 Video Detection System

A. Video Camera Sensor Assembly

Video camera sensor assemblies, complete in place and accepted by the Department, are paid for at the Contract Unit Price. Payment is full compensation for furnishing and installing the video camera sensor assembly.

B. Video Detection System Processor, Type A

Video detection system processors, complete in place and accepted by the Department, are paid for at the Contract Unit Price. Payment is full compensation for furnishing and installing the video detection system processor.

C. Video Detection System Processor, Type B

Video detection system processors complete in place and accepted by the Department, are paid for at the Contract Unit Price. Payment is full compensation for furnishing and installing the video detection system processor.

D. Testing

The Department will pay for testing performed as prescribed by this Item, measured as provided under Measurement at the Lump Sum Contract bid price.

E. Training

The Department will pay twenty-five (25%) of the total Lump Sum Contract bid amount for training upon approval of the Training Plan. The Department will pay the remaining seventy-five (75%) after completion of all training as described in Subsections 937.2.01. The total sum of all payments cannot exceed the original contract amount for this item.

Payment is full compensation for furnishing and installing the items complete in plans according to this Specification.

937.5.02 Microwave Detection System

A. Microwave Radar Detector Assembly

Microwave radar detection assemblies paid for are the number actually installed, complete, functional, and accepted. Unless otherwise specified in the Plans, furnish and install the following minimum items for a microwave video detection assembly:

- Microwave radar detector
- Housing
- Field cabling and cabinet equipment
- Power supply
- Mounting bracket(s)
- All weatherheads, vertical conduit risers, and conduit hardware on the support pole for power and detector signal as shown in the plans
- Configuration

B. Testing

Testing is paid for as a lump sum for full delivery of testing and acceptance requirements, measured as provided under Measurement at the Lump Sum Contract bid price

C. Training

Training is paid for as a lump sum for all supplies, equipment, materials, handouts, travel, and subsistence necessary to conduct the training, measured as provided under Measurement at the Lump Sum Contract bid price

Payment is full compensation for furnishing and installing the items complete in plans according to this Specification.

937.5.03 Intersection Video Detection

A. Intersection Video Detection Assembly

Intersection Video Detection System Assemblies paid for are the number actually installed, complete, functional, and accepted. Unless otherwise specified in the Plans, furnish and install the following minimum items for an Intersection Video Detection System Assembly:

1. Type A
 - a. Video Camera Sensor:
 - 1) Camera, environmental enclosure, variable focal length lens, mounting bracket assembly, with all associated hardware and incidental materials
 - 2) Electric Lens Adjustment Device; if more than one video camera sensor is installed at an intersection, provide one Electric Lens Adjustment Device for that intersection

- 3) Field cabling and cabinet equipment, including but not limited to power and video cabling from the video camera sensor to the controller cabinet, processor module, power and coax termination panels, surge suppressor, cabinet wiring, and all associated hardware and incidental materials. If more than one Intersection Video Detection Assembly and/or video camera sensor is installed at an intersection or ramp meter installation, provide one power termination panel and one coax termination panel for that intersection or ramp meter installation.
 - 4) All weather heads, vertical conduit risers, and conduit hardware on the I-VDS support pole for power and video signal as shown in the Plans
- b. Processor Module:
- 1) Provide one Processor Module, Type A
 - 2) Configuration and processor software on the processor module
 - 3) Programming Device; if more than one Processor Module is installed in a cabinet at an intersection, provide one Programming Device for that cabinet
2. Type B
- a. Video Camera Sensor:
- 1) Provide two (2) cameras, environmental enclosures, variable focal length lenses, mounting bracket assemblies, and junction boxes with all associated hardware and incidental materials
 - 2) Electric Lens Adjustment Device; if more than one video camera sensor is installed at an intersection, provide one Electric Lens Adjustment Device for that intersection
 - 3) Field cabling and cabinet equipment, including but not limited to power and video cabling from the video camera sensors to the controller cabinet, processor modules, power and coax termination panels, surge suppressors, cabinet wiring, and all associated hardware and incidental materials. If more than one Intersection Video Detection Assembly and/or video camera sensor is installed at an intersection or ramp meter installation, provide one power termination panel and one coax termination panel for that intersection or ramp meter installation.
 - 4) All weather heads, vertical conduit risers, and conduit hardware on the I-VDS support pole for power and video signal as shown in the Plans
- b. Processor Module:
- 1) Provide one Processor Module, Type B or C
 - 2) Configuration and processor software on the processor module
 - 3) Programming Device; if more than one Processor Module is installed in a cabinet at an intersection, provide one Programming Device for that cabinet

3. Output Expansion Module

Output expansion modules paid for are the number actually installed, complete, functional, and accepted. Unless otherwise specified in the Plans, furnish and install an Output Expansion Module to include, at a minimum, the following:

- Output expansion module
- Any cabling required to connect to the processor module or additional expansion modules

4. Programming Monitor

A Programming Monitor is measured for payment by the number actually furnished and accepted. Unless otherwise specified in the Plans, furnish a Programming Monitor to include, at a minimum, the following:

- Programming Monitor
- Video input Switching Device

- Any cabling required to connect the processing modules to the programming monitor

5. Testing

Testing is paid for as a lump sum for full delivery of testing and acceptance requirements, measured as provided under Measurement at the Lump Sum Contract bid price

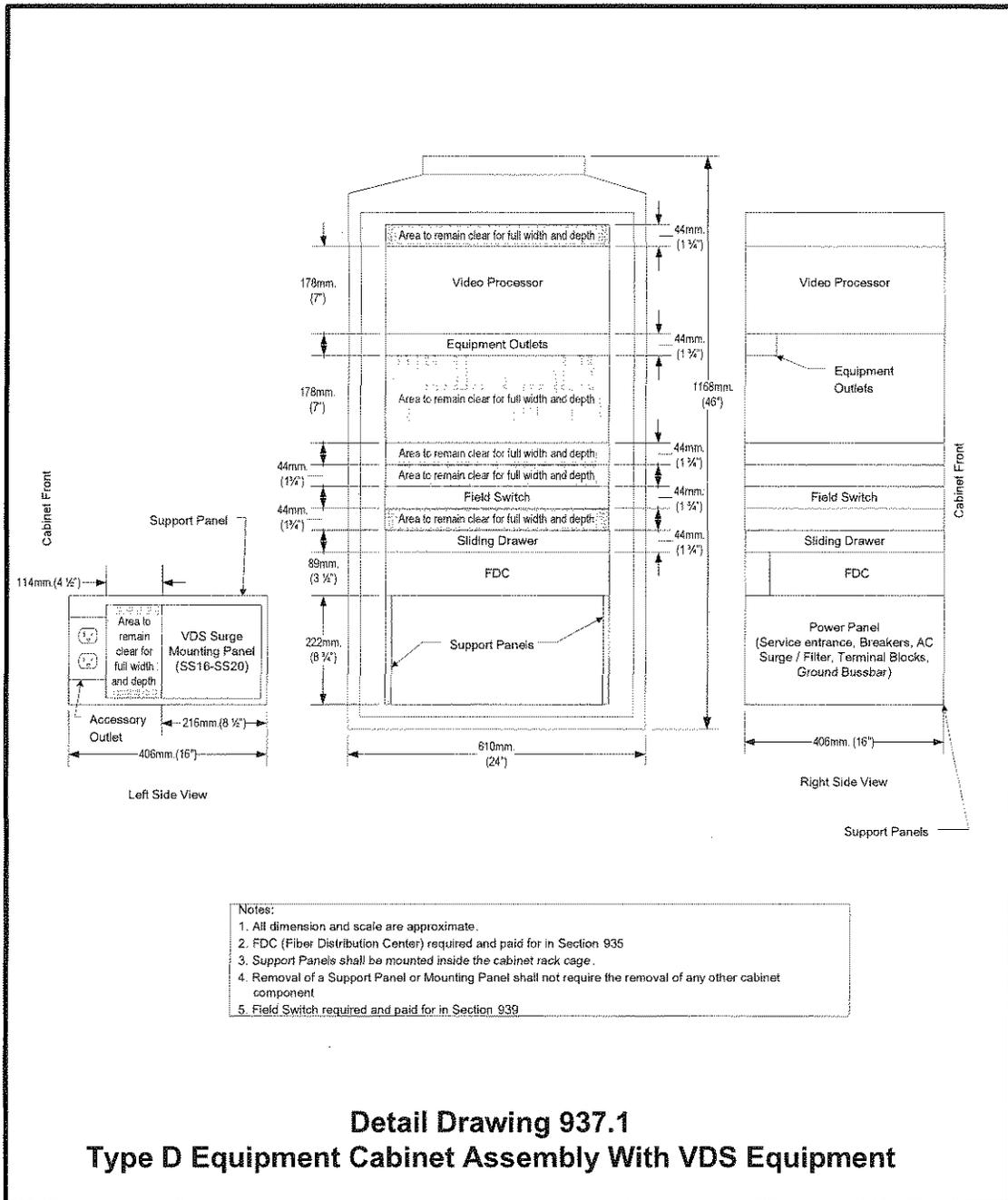
6. Training

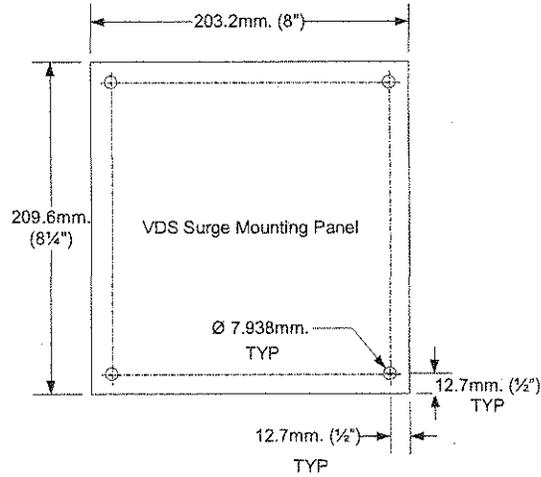
Training is paid for as a lump sum for all supplies, equipment, materials, handouts, travel, and subsistence necessary to conduct the training, measured as provided under Measurement at the Lump Sum Contract bid price

Payment will be made under:

Item No. 937	Video Camera Sensor Assembly	Per Each
Item No. 937	VDS System Processor, Type _	Per Each
Item No. 937	Testing - Video Detection System	Lump Sum
Item No. 937	Training - Video Detection System	Lump Sum
Item No. 937	Microwave Radar Detection Assembly	Per Each
Item No. 937	Testing - Microwave Detection System	Lump Sum
Item No. 937	Training - Microwave Detection System	Lump Sum
Item No. 937	Intersection Video Detection System Assembly, Type _	Per Each
Item No. 937	Output Expansion Module, Type _	Per Each
Item No. 937	Programming Monitor, Type _	Per Each
Item No. 937	Testing – Intersection Video Detection	Lump Sum
Item No. 937	Training – Intersection Video Detection	Lump Sum

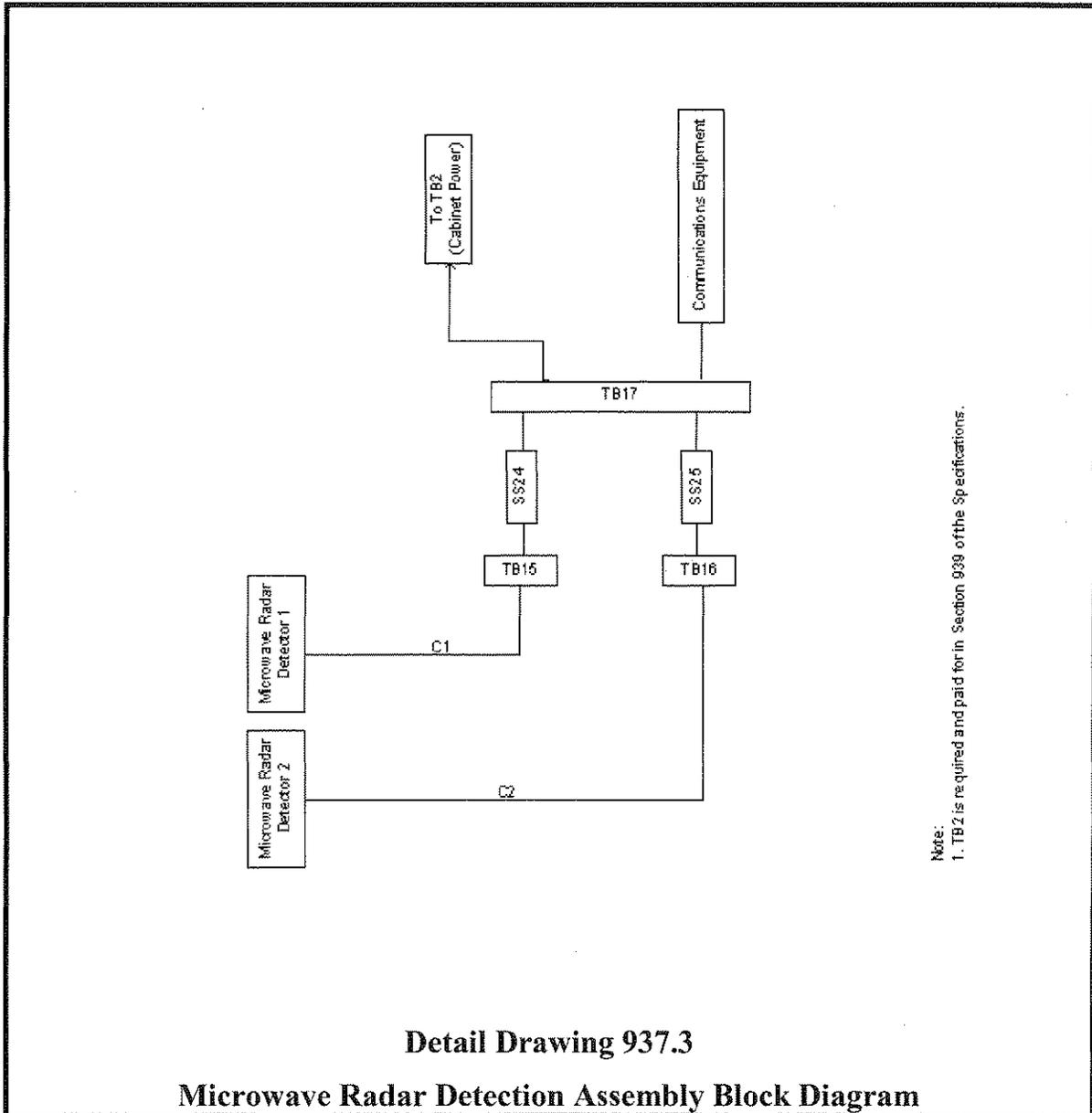
Traffic Operations





Note:
1. All linear dimensions ± 0.005 " tolerance.
2. Drawing not to scale
3. Mounting Panel shall be 0.125" 5052 Aluminum

Detail Drawing 937.2
VDS Surge Mounting Panel, Type D Cabinet



**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA**

SPECIAL PROVISION

P.I. No.: 0010290 & 0010311

**Fulton County
Forsyth County**

Section 939—Communication and Electronic Equipment

Delete Section 939 and substitute the following:

Section 939 –Communication and Electronic Equipment

939.1 General Description

This work includes installation, acceptance testing, warranty, and guaranty of items that are either components of several NaviGator subsystems or elements of the communication network.

Provide all equipment and materials of like kind and function to be of the exact same manufacture, model, revision, firmware, etc.

Provide all equipment, materials, and work in accordance with all manufacturers' recommendations.

939.1.01 Definitions

- Caltrans TEES – Caltrans Transportation Electrical Equipment Specifications, as published by the State of California Business, Transportation & Housing Agency; Department of Transportation, Current Edition, and all current addenda.
- Caltrans TSCES – Caltrans Traffic Signal Control Equipment Specifications, as published by the State of California Business, Transportation & Housing Agency; Department of Transportation, Current Edition, and all current addenda.
- Type A Cabinet – The Type A cabinet housing is a standard Model 336 stretch (336S) housing with approximate exterior dimensions of 46 in. (1.2 m) (H) x 24 in. (0.61 m) (W) x 23 in. (0.58 m) (D).
- Type B Cabinet - The Type B cabinet housing is a standard Model 337 housing with approximate exterior dimensions of 35 in. (0.89 m) (H) x 20 in. (0.5 m) (W) x 17 in. (0.43 m) (D).
- Type C Cabinet - The Type C cabinet housing is a standard Model 332 housing with approximate exterior dimensions of 64 in. (1.6 m) (H) x 24 in. (0.61 m) (W) x 30 in. (0.76 m) (D).
- Type D Cabinet – The Type D cabinet housing is a standard Model 336 stretch (336S) housing with approximate exterior dimensions of 46 in. (1.2 m) (H) x 24 in. (0.61 m) (W) x 23 in. (0.58 m) (D). The difference between a Type D and Type A cabinet is the difference in interior cabinet configuration as shown in the Detail Drawings in this section.
- Type F Cabinet - The Type F cabinet housing shall be a standard ITS Cabinet Housing #3 with approximate exterior dimensions of 67 in. (1.7 m) (H) x 44 in. (1.2 m) (W) x 26 in. (0.66 m) (D).

939.1.02 Related References

A. Georgia Standard Specifications

- Section 631 – Permanent Changeable Message Sign
- Section 682 – Electrical Wire, Cable and Conduit
- Section 797 – Buildings
- Section 922 – Electrical Wire and Cable
- Section 923 – Electrical Conduit
- Section 925 – Traffic Signal Equipment
- Section 935 – Fiber Optic System
- Section 936 – Closed Circuit Television System (CCTV)
- Section 937 – Video Detection System
- Section 938 – Detection
- Section 940 – NaviGator Advanced Transportation Management System Integration

B. Referenced Documents

- American Society of Testing and Materials (ASTM)
- American National Standards Institute (ANSI)
- Caltrans TEES
- Canadian Standards Association (CSA)
- Deutsches Institut für Normung {German Institute for Standardization} (DIN)
- Electronics Industry Association (EIA)
- Standards of the European Committee for Standardization (EN)
- ICEA Table K.2/Method 1
- Institute of Electrical and Electronics Engineers (IEEE)
- International Electrotechnical Commission (IEC)
- International Standards Organization (ISO)
- International Telecommunications Union (ITU)
- Motion Pictures Expert Group (MPEG)
- National Electric Code (NEC)
- National Electric Safety Code (NESC)
- National Electrical Manufacturers Association (NEMA)
- National Television System Committee (NTSC)
- National Transportation Communications for ITS Protocol (NTCIP)
- Telecommunications Industry Association (TIA)
- Underwriter’s Laboratory Incorporated (UL)
- Association for Electrical, Electronic & Information Technologies [Germany] (VDE)

939.1.03 Submittals

The following chart provides the Contractor with an outline of the submittal requirements for the equipment and components for this pay item. This chart is to be used as a guide and does not relieve the Contractor from submitting additional information to form a complete submittal package.

Section 939 Submittal Requirements								
Item	Specification Subsection	Catalog Cuts	Factory Specifications	Independent Test Lab Certification	Installation Procedure	Test Plans	Maintenance Procedures	Submittal Due Date (Cal. Days after NTP)
Serial Data Terminal Server (All Types)	939.2.02	X	X		X	X	X	60 Days
Patch Cords	939.2.03	X	X					60 Days
Hub UPS	939.2.04	X	X		X	X	X	60 Days
Network Switch, Layer 3 Gig-E (All Types)	939.2.05	X	X	X	X	X	X	60 Days
GBIC Routing Switch Module (All Types)	939.2.06	X	X	X	X	X	X	60 Days
GBICs (All Types)	939.2.07	X	X	X	X	X	X	60 Days
Field Switch (All Types)	939.2.08	X	X	X	X	X	X	60 Days
Video Encoder (All Types)	939.2.09	X	X	X	X	X	X	60 Days
Video Decoder (All Types)	939.2.10	X	X	X	X	X	X	60 Days
Equipment Rack	939.2.11	X	X	X	X			60 Days
Equipment Frame	939.2.12	X	X	X	X			60 Days
Dial-up modem	939.2.13	X	X		X	X	X	60 Days
Equipment Cabinet Assembly (All Types)	939.2.13.A	X	X		X	X	X	60 Days
Training Plan	939.3.08				X		X	60 Days

- Submit submittal data for all equipment, materials, test procedures, and routine maintenance procedures required for these items within sixty (60) calendar days after the Notice To Proceed and prior to any installation, unless noted otherwise in the Contract Documents.
- Submit to the Engineer for approval, two (2) copies of the manufacturer's descriptive literature (catalog cuts), technical data, operational documentation, service and maintenance documentation and all other materials required within these specifications. An electronic copy, which includes all the aforementioned documents, shall be placed on a CD as pdf documents and delivered to the Engineer.
- Provide submittal data that is neat, legible, and orderly. Neatly organize each package of submittal data and separate by hardware item. Use the "Materials Certification Package Index and Transmittal Form", contained in Section 105.02 of the Special Provisions, for each pay item to document and list all material and components that are included in the submittal package. Any submittal data submitted without the Index/Transmittal form or that is incomplete will be rejected.

A. Equipment

Equipment

Materials submittal data for items specified herein shall include, but not be limited, equipment performance and technical specifications, electrical/power specifications, size/weight/mounting configuration requirements, and environmental operating conditions.

Provide a diagram showing the location of all equipment within the TCC, Hub and/or Equipment Cabinet, 30 days prior to any installation activities at the site. Include in this diagram the dimensions, power requirements, power service materials and heat dissipation specifications for all of the equipment.

Submit and provide all equipment and corresponding ancillary and incidental materials of a like kind to be the exact same manufacturer, model, revision, firmware, etc. for the entire quantity in the project. Like kind equipment shall include but is not limited to serial data terminal servers, uninterruptible power supplies, network switches, GBIC routing switch modules, GBICs, field switches, video encoders and decoders, equipment racks, equipment frames, and dial-up modems.

Submittal Review Demonstration Test Set

Submit demonstration test set(s) for Department evaluation after the Engineer approves the submittal materials for the equipment and materials listed below. The demonstration test sets shall be connected to and operated through the NaviGATOR system by the Engineer. Deliver the test set to the Department at the location specified by the Engineer. Request a delivery and test time a minimum of 30 days in advance. Provide demonstration test sets of the materials, types and quantities as shown below:

- Serial Data Terminal Server, all types (quantity 2 of each type)
- Network Switch, Layer 3 Gig-E, all types (quantity 1 of each type)
- Field Switch, all types (quantity 4 of each type)
- Video Encoder, all types (quantity 2 of each type)
- Video Decoder, all types (quantity 2 of each type)

A demonstration test set shall include all materials, components, assemblies, control software and documentation of the equipment and shall be complete and fully functional for communications with the NaviGATOR system. All equipment shall be configured for locating on a benchtop, or else provide a desktop stand to secure the equipment. Provide a high-density chassis cage for video encoders and decoders when the cage is required on a project. Provide an RS232 serial cable for console connection for each type of equipment item. Provide a NEMA 5-15 cord for power service to all equipment.

Review of the demonstration test set submittal shall be conducted in two parts. The first part of the review shall be performed by the Contractor in the presence of the Engineer and shall include the setup and configuration of the demonstration test set on the NaviGATOR system. The first part of the review shall be conducted during normal Department weekday business hours and shall be conducted for the period of time necessary to the satisfaction of the Engineer. The second part of the review shall be a 60-day period during which the Engineer shall operate and evaluate the demonstration test set with the NaviGATOR system. The second part of the review shall commence only upon the Engineer's approval of the first part of the review. Retrieve the demonstration test set upon completion of the second part of the review as notified by the Engineer.

B. Testing

Provide test equipment and system set-up and diagnostic software required for the testing, operation, maintenance and troubleshooting of the equipment, along with Operations, Installation and Maintenance manuals for these software packages.

Submit all testing plans and procedures for Department approval in accordance with the chart above.

C. Equipment Cabinet Assembly

Submit materials submittal data for the equipment cabinet and all individual component and hardware items that make up the complete assembly. These items shall include, but are not limited to, cabinet shell specifications, electrical component description and performance specifications, wiring and cabling equipment and materials, electrical/power specifications, and all documentary items.

Submit materials submittal data for all materials and hardware necessary for the patch and electrical cabling, conduit and power service. These items include but are not limited to cabling, wire and conduit materials, service disconnect breaker/surge suppression/termination/housing description and performance specifications, ground rod and conductor, proposed conduit route from service point to equipment cabinet, and all miscellaneous hardware and accessories.

Submit and provide all equipment cabinet assemblies and corresponding ancillary and incidental materials of a like kind from the exact same manufacturer, model, revision, firmware, etc. for the entire quantity in the project. Like kind equipment shall include, but is not limited to, cabinet housings, internal cabinet assembly components, and electrical components including surge suppressors, terminal blocks, rack-mount equipment outlets, and side and support panels.

939.2 Materials

939.2.01 Not Applicable

939.2.02 Serial Data Terminal Server

Provide multiport Serial Data Terminal Servers (terminal servers) that are compatible with the existing NaviGator serial port control system. The existing serial port control system consists of serial data terminal servers (Digiboard PortServer II) addressed with the Digiboard RealPort system interface.

Ensure all terminal servers meet the following requirements:

- Compatible with the existing NaviGator serial port control system.
- IP addressable supporting Ethernet 10/100Base-T/TX with RJ45 port.
- RS-232 serial ports with RJ45 ports.
- Management access by HTTP, telnet, and console ports, all password protected.
- SNMP read/write management of terminal server and individual serial ports.
- Each serial port individually configurable comm. settings and TCP/UDP socket support.
- Each serial port with minimum 64kbps buffering and data capture.
- Firmware upgradeable by FTP/TFTP.
- Upload/download of configuration settings.
- Diagnostic LEDs for Ethernet connection and unit status.
- UL approval.

Ensure Serial Data Terminal Server, 16 Port, meet the following additional requirements:

- EIA 19-inch rack-mounted units with maximum vertical height of 1.75 inch (44.4 mm).
- 16 RS-232 ports mounted on the front of the unit.
- Internal 120VAC power supply.

Ensure Serial Data Terminal Server, Type B, meet the following additional requirements:

- Operating temperature of unit and power supply of -31°F to 165°F (-35°C to 74°C).
- Conformal-coated circuit boards.
- Capable of being panel-mounted, rack-mounted and shelf-mounted in equipment cabinets.
- Minimum of two (2) RS-232 ports mounted on the front of the unit.
- Internal or external 120VAC power supply.

939.2.03 Patch Cords

General Requirements:

- a. Provide all necessary patch cords with all electronic equipment for interconnection. Verify that patch cords consist of a length of cable that is connectorized on both ends, primarily used for interconnecting termination or patching facilities and/or equipment.
- b. All patch cords shall be factory assembled and connectorized and be certified by the patch cord manufacturer to meet the relevant performance standards required below. All connectors shall incorporate mechanical cable strain relief and protective boots.
- c. Coaxial Video Patch Cords: Ensure that coaxial video patch cords are 75-ohm precision double-shielded cables with tinned copper braid shield and minimum #22AWG solid copper stranded center conductor. Use BNC

connectors with gold-plated center pins at both ends. Connectorized coaxial video patch cords shall be 100% sweep tested. Provide only adapters with gold-plated pins.

- d. Network/Field Switch/Data Patch Cords: Verify that network//field/data patch cords meet all ANSI/EIA/TIA requirements for Category-6 4-pair unshielded twisted pair cabling with stranded conductors and RJ45 connectors.
- e. Voice/Telephone Patch Cords: Provide voice/telephone patch cords that meet all ANSI/EIA/TIA requirements for Category 3 unshielded twisted pair cabling with stranded conductors, unless otherwise required by the voice/telephone equipment manufacturer.
- f. Fiber Optic Patch Cords: Provide fiber optic patch cords that meet all requirements of Section 935.

939.2.04 Hub Uninterruptible Power Supply

Ensure the Hub UPS provides AC back-up power for network electronics and other equipment as shown in the contract documents. Provide a Hub UPS meeting the following requirements:

- 19" rack mounted, maximum height of six (6) rack units (10.5").
- 120 VAC single phase 60 HZ output
- Input line cord plug type NEMA L5-30P
- 8 output receptacles type NEMA5-15R
- Pure sine wave output at 115 VAC +/- 5%
- Transfer time of 4 ms or less
- Capacity of 2200 VA/1600 W
- Load factor range of 0.5 to 1.0
- Peak current capability of 6.5 KVA
- Software adjustable high and low voltage buck/boost function
- SNMP manageable hardware and software with 10Base-T connection (RJ-45)
- Addressable SNMP command set shall minimally include: UPS state, battery condition (capacity, age, internal temperature); current AC input conditions (voltage, phase, frequency, failure condition); current AC output conditions (voltage, frequency, load); and diagnostic/self-test control and status.
- Remote environmental sensing hardware and software integrated with SNMP minimally capable of temperature and humidity monitoring and 4 dry contact closures
- Network connection to Ethernet port on Hub Network Switch, Layer 3 GigE
- Printed and electronic user documentation for all management, configuration and operation hardware and firmware settings, installation procedures, and the MILB.
- Sealed maintenance-free lead-acid batteries
- Maximum audible noise of <53 dBA at 3 ft (0.9 m).
- Upgradeable for increased runtime capacity (minimum 2.5X) with additional battery packs
- Expansion battery pack that is 19" rack mounted, with maximum height of five (5) rack units (8.75").

939.2.05 Network Switch, Layer 3 GigE

Furnish a Gigabit Ethernet Layer 3 network routing switch that is compatible with the existing GDOT Ethernet switching network. The existing network consists of Nortel Networks 8600 Layer 3 routing switches. The network switches shall be manageable using the Department's existing Device Manager network management software. Furnish and configure the network switches as complete compatible assemblies. Configure the network switch(es) at the locations shown in the Plans, as applicable, to the following minimum requirements:

- Minimum 6-slot chassis with hot-swappable card capability

- Two (2) Enterprise Routing Switch Module CPU/Switch Fabric Modules with PCMCIA flash memory card and a processing capability of 380 million packets-per-second
- One (1) 30-port 1000 Base SFP GBIC Routing Switch Module.
- One (1) 48-port auto-sensing 10/100/1000 Base-T/TX Ethernet Layer 3 switching interface Module.
- Three (3) 100-240VAC power supplies including North American power cables, configured for 120VAC service
- Ethernet Routing Switch 8600 software license, latest version, including license, agent software, management software, and all software documentation
- EIA 19" rack mounted

Additionally configure each Network Switch, Layer 3 GigE, Type E, with four (4) Type E GBICs. Include four (4) duplex fiber optic single-mode patch cords, 30 ft. (9 m) in length, in accordance with Section 935 and with ST-connectors on one end (at the FDC) and an LC-connector on the other end (at the network switch.)

Additionally configure each Network Switch, Layer 3 GigE, Type F, with four (4) Type E GBICs and four (4) Type F GBICs. Include eight (8) duplex fiber optic single-mode patch cords, 30 ft. (9 m) in length, in accordance with Section 935 and with ST-connectors on one end (at the FDC) and an LC-connector on the other end (at the network switch.)

939.2.06 GBIC Routing Switch Module

Provide a GBIC Routing Switch Module, Type B, which consists of 30-1000Base SFP GBIC ports populated with GBICs as called-out on the Plans and as specified herein. All Modules and GBICs provided shall be compatible with the Network Switch, Layer 3 GigE.

939.2.07 GBIC (Gigabit interface converter)

The GBICs shall meet the following minimum requirements:

- a. Support single-mode operation
- b. Fully compliant with IEEE 802.3z standards
- c. Operate at 1000Mbps and full-duplex two fiber operation supporting the following types:
 - GBIC, Type A (LX): (SMFO at 1310nm); optical link budget: 10.5dB, typical
 - GBIC, Type B (XD): (SMFO at 1550nm); optical link budget: 17.0dB, typical
 - GBIC, Type C (ZX): (SMFO at 1550nm); optical link budget: 22.0dB, typical
 - GBIC, Type D (SFP LX): (SMFO at 1310nm); optical link budget: 10.5dB, typical
 - GBIC, Type E (SFP XD): (SMFO at 1550nm); optical link budget: 17.0dB, typical
 - GBIC, Type F (SFP ZX): (SMFO at 1550nm) optical link budget: 20.0dB, typical
 - GBIC, Type G (SFP SX): (MMFO at 850nm) optical link budget: 7.0dB, typical
- d. Allow for hot swapping failed components.
- e. Operate as its own switched port.
- f. Support detecting and shutting down one-way link failures, using auto-negotiation.
- g. The GBIC optical receiver saturation level shall be greater or equal to the maximum optical output of the mating transmitter minus 5db. Where required for manufacturer's recommended operations, provide fiber optic patch cords in accordance with Section 935 with integral optical attenuators for optical power control in accordance with the Ethernet switch (network switch, field switch, etc.) manufacturer's recommendations.
- h. GBICs, all types, furnished with field switches shall meet the same environmental operating requirements as the field switch.

All Field Switches shall meet the following requirements:

a. General Characteristics and Capabilities:

- 1) Meet the IEEE 802.3 (10Mbps Ethernet) standard.
- 2) Meet the IEEE 802.3u (Fast Ethernet 100 Mbps) standard
- 3) Provide Gigabit-Ethernet SFP GBIC sockets as specified in Field Switch Types subsection.
- 4) Provide a minimum of six (6) 10/100 Base-T/TX ports unless otherwise specified in the Field Switch Types subsection. Each 10/100Base-T/TX port shall connect via RJ45 connector. The ports shall operate as half-duplex or full-duplex (IEEE 802.3x) over 100m segment lengths and provide auto-negotiation.
- 5) Bit Error Ratio (number of erroneous bits divided by the total number of bits transmitted, received, or processed) shall not increase over the optical channel when two units are connected with a fiber optic jumper having total optical losses of 6dB, including connector losses.
- 6) Operate non-blocking, at full wire speed
- 7) Support remote reset and remote management
- 8) Minimum MTBF of 100,000 hrs using Bellcore TS-332 standard.

b. Network Capabilities and Features:

The Field Switch shall support/comply with the following minimum requirements:

- 1) Provide full implementation of IGMPv2 and IGMP snooping
- 2) Meet the IEEE 802.3x (Full Duplex with Flow Control) standard.
- 3) Meet the IEEE 802.1p (Priority Queuing) standard.
- 4) Meet the IEEE 802.1Q (VLAN) standard per port for up to four VLAN's.
- 5) The switch shall meet the IEEE 802.1D (Spanning Tree Protocol) and IEEE 802.1w (Rapid Spanning Tree) standards.
- 6) Meet the IEEE 802.3ad (Link Aggregation) standard for a minimum of two groups of four ports.
- 7) Full implementation of GVRP (Generic VLAN Registration Protocol).

c. Port Security:

The Field Switch shall support/comply with the following (remotely) minimum requirements:

- 1) Ability to configure static MAC addresses access
- 2) Ability to disable automatic address learning per ports; know hereafter as Secure port. Secure Ports only forward statically configured Mac addresses.
- 3) Trap and alarm upon any unauthorized MAC address and shutdown. Port shutdown requires administrator to manually reset the port before communications are allowed.

d. Network Management Functions:

The Field Switch shall support/comply with the following minimum requirements:

- 1) Password manageable
- 2) Full implementation of SNMPv1 and SNMPv2c.
- 3) Full implementation of RMON I statistics, history, alarms, and events objects.
- 4) Capable of mirroring any port to any other port within the switch.

e. Remote Management and Configuration:

The Field Switch shall support/comply with the following minimum requirements:

- 1) SNMP
- 2) Telnet/CLI
- 3) HTTP (Embedded Web Server) with Secure Sockets Layer (SSL).
- 4) Full implementation of RFC 783 (TFTP) to allow remote firmware upgrades.

f. Mounting:

The Field Switch shall be rack mountable as shown on the Detail Drawings in this section. All necessary hardware and adaptors for mounting shall be included. Provide a perforated shelf and secure with rack mounting hardware for a Field Switch that is not rack mountable with integral "rack ears."

Provide a sufficient quantity of fiber optic patch cords to match the populated optical ports on the Field Switch. Include duplex fiber optic single-mode patch cords, 3 ft. (1 m) in length, in accordance with Section 935 and with ST-connectors on one end (at the FDC) and an LC-connector on the other end (at the Field Switch.)

g. Environmental:

The Field Switch shall support/comply with the following minimum requirements:

- 1) Operate between -34 to +74 degree Celsius. (-29°F to +165°F). No fans are permitted.
- 2) Operate from 10% to 90% humidity
- 3) Maximum size of 1 rack unit high by 12.5 in (320 mm) deep

h. Electrical/Safety:

The Field Switch shall support/comply with the following:

- 1) Operate from 100 VAC to 200 VAC (120VAC nominal, 60Hz) as shown on the Detail Drawings in this section.
- 2) The Field Switch shall be provided with all power conversion which is temperature hardened from -34 to +70 degrees Celsius (-29°F to +165°F) and all regulation necessary to support electronics operation. The power input circuitry shall be designed to protect the electronics from damage by a power surge or under voltage condition.
- 3) All power transformers provided shall be "fastening mechanism" type. No plug-in types will be provided. All corded transformers shall be mountable with the ability to neatly secure power cords.
- 4) Include UL approval
- 5) Provide rubber dust caps/covers with insertion/removal handles that completely seal the port opening for all unused copper and optical ports.

i. Status Indicators:

The Field Switch shall support/comply with the following minimum requirements:

- 1) Power: On, Off
- 2) Network Status per port: Transmit, Receive, Link, Speed
- 3) Status indicators shall be LED.

j. Field Switch Types:

In addition to meeting all the requirements specified herein, the Field Switch SFP GBIC sockets shall be populated as indicated on the Plans. The Field Switch types are defined as follows:

- Field Switch, Type A – provide a minimum of three (3) Gigabit-Ethernet SFP GBIC sockets, populated with three (3) GBIC, Type D (SFP LX)
- Field Switch, Type B – provide a minimum of three (3) Gigabit-Ethernet SFP GBIC sockets, populated with one (1) GBIC, Type D (SFP LX) and two (2) GBIC, Type E (SFP XD)

- Field Switch, Type C – provide a minimum of two (2) Gigabit-Ethernet SFP GBIC sockets, populated with two (2) GBIC, Type D (SFP LX)
- Field Switch, Type D – provide a minimum of two (2) Gigabit-Ethernet SFP GBIC sockets, populated with one (1) GBIC, Type D (SFP LX) and one (1) GBIC, Type E (SFP XD)
- Field Switch, Type E – provide a minimum of two (2) Gigabit-Ethernet SFP GBIC sockets, populated with two (2) GBIC, Type E (SFP XD)
- Field Switch, Type F – provide a minimum of eight (8) Gigabit-Ethernet SFP GBIC sockets, populated with four (4) GBIC, Type D (SFP LX). One 10/100 Base-TX port is required unless otherwise specified.
- Field Switch, Type G – provide a minimum of (3) Gigabit-Ethernet SFP GBIC sockets, populated with two (2) GBIC, Type D (SFP LX) and one (1) GBIC, Type E (SFP XD)

939.2.09 Video Encoder (All Types)

Provide a Video Encoder in accordance with the minimum requirements below for the encoding of analog video inputs and transmission as digital streams over a network.

A. Video Encoder, Type B

Video Encoder, Type B is a standalone, environmentally hardened encoder for a single video signal, suitable for field cabinet use.

1. General

a. Chassis

- 1) Furnish rack-mountable or shelf-mountable units.
- 2) Rack-mountable units shall include integrated brackets for mounting in standard EIA 19-inch rack rack-mountings, and shall be no more than one (1) rack unit (1.75 inches (45 mm)) high and 13 in. (330 mm) deep.
- 3) Shelf-mountable units shall be no more than 3.5 in. (89 mm) (H) x 9 in. (229 mm) (W) x 11 in. (280 mm) (D), and shall include a perforated ventilated shelf for mounting in a standard EIA 19-inch rack, no more than 13 inches (330 mm) deep with mounting flanges of two (2) rack units (3.5 in. (89 mm)) and a minimum 20 lb (9 kg) load rating.

b. Labeling and Identification

- 1) Provide external silk-screened markings for all connectors, indicators, switches, and replaceable components.
- 2) Provide external labeling on the front or rear enclosure face for the manufacturer's name, product, model and part numbers, revision numbers, serial number, and MAC address.

c. Environmental

- 1) Operating temperature of -30 degrees F (-34 C) to 165 degrees F (74 C) with relative humidity between 10% to 90% non-condensing.
- 2) Ventilation fans are not permitted.

d. Power

- 1) Nominal power input voltage of 120 VAC.
- 2) Maximum power consumption of 20 watts.
- 3) If external power supplies are used, they shall fit into the allotted space for the encoder, and shall meet the same operating temperature and relative humidity requirements.

e. Connectors

- 1) Video Input: BNC connector with gold-plated center socket.
- 2) Network: RJ-45 jack

- 3) Serial Data: 9-pin D-subminiature (DE-9), keyed pluggable locking terminal block, or keyed locking connector jack. If DE-9 connector is used, comply with TIA-574. If keyed locking connector jack is used, furnish an adapter cable (no greater than 1m in length) with the required DE-9F/TIA-574 connector and labeled "DATA".
 - 4) Console: Female 9-pin D-subminiature (DE-9F) connector for RS-232 DCE (data circuit equipment) console interface compliant with TIA-574. If encoder housing has a connector interface other than DE-9F, furnish an adapter cable (no greater than 1m in length) with the required DE-9F connector for each encoder and labeled "CONSOLE".
 - 5) Power: NEMA 5-15 plug
2. Interfaces
- a. Video Input: Color NTSC signal, 1 volt peak-to-peak.
 - b. Serial Data
 - 1) RS-232 operation, bidirectional with minimum data receive, data transmit, and ground signal connections.
 - 2) Baud-rate selectable between 1200 and 38400 bits per second.
 - 3) Line parameters of 1 start bit, 8 data bits, no parity, and no flow control.
 - c. Console: RS-232 operation for PC communications.
 - d. Ethernet
 - 1) IEEE 802.3/802.3u 10/100Mbps Ethernet.
 - 2) Auto-negotiation of speed/duplex operation according to IEEE 802.3ab.
3. Network Communication
- a. Provide a fully functional IP stack and interface that is both standards compliant and consistent with established practices. IP stack must include TCP (per RFC 793), UDP (per RFC 768), IGMPv2 (per RFC 2236), ARP (per RFC 826), ICMP (per RFC 792), SNMP (per RFC 1157), and unicast/broadcast/multicast support.
 - b. Provide statically configurable IP address, subnet netmask, and default gateway.
 - c. Provide support for managing the following network communication parameters via the Local Management functionality required herein.
 - IP Address
 - Subnet Mask
 - Default Gateway
4. Video Encoding and Streaming
- a. Encode video input using ISO/IEC 14496-2:2004/Amd.2:2005 MPEG-4 Part 2 Simple Profile Level 5 or ISO/IEC 14496-2:2004 MPEG-4 Part 2 Advanced Simple Profile Level 5.
 - b. Support streaming via RTP (per RFC 3550) to configurable unicast or multicast address and port.
 - c. Support configurable multicast time-to-live (TTL) parameter.
 - d. Maintain 4:3 frame aspect ratio.
 - e. Support the following simultaneous settings:
 - Minimum encoded image resolution of 704x480
 - 30 frames-per-second frame rate
 - I-to-P (group of pictures) ratio of 1:30
 - 4Mbps encoding bit rate
 - Constant bit rate encoding or constrained variable bit rate encoding

- f. Support access to SDP file (per RFC 4566) matching current stream configuration via HTTP (per RFC2616), RTSP (per RFC 2336), or SAP (per RFC 2974).
 - g. Upon loss of sync on the video input, continue streaming with a solid black image or some indication of "video loss" other than interrupting the stream.

 - h. Any on-screen text or title overlay features shall be configurable to be fully disabled.
 - i. Provide maximum encoding and transmission latency of 300 milliseconds with minimal transmission jitter and no video image degradation or transmission interruptions.
 - j. RTP packet stream's timestamp is derived from the encoder's 90KHz clock reference. Reference clock must be synchronized with the actual wall-clock time and the MPEG4 stream, with no noticeable clock drift, for an interval of at least one (1) hour.
 - k. Provide support for managing the following video streaming parameters via the Remote Management functionality required herein.
 - Target address and port
 - TTL parameter
 - Resolution
 - Frame rate
 - I/P ratio
 - Encoding bit rate
 - On-screen text or title overlay features
5. Serial Data Communication
- a. Support network/serial data pass-through operation via UDP or TCP.
 - b. Pass traffic between the UDP/TCP port and the serial data port without modifying the payload, defined as raw pass-through with no TELNET or other character escaping.
 - c. Support configurable TCP or UDP listener port number.
 - d. UDP network/serial data pass-through implementation shall not require pre-configuration of the IP address for return traffic from an attached serial device. Forwarding incoming serial data to the originating source address and port of the most recently received UDP pass-through traffic is an acceptable implementation.
 - e. TCP network/serial data pass-through implementation shall include a method of automatic network fault recovery initiated by the encoder in 60 seconds or less. TCP keepalives with configurable parameters for inactivity period, number of probes to send, and probe timeout interval is an acceptable implementation.
 - f. Provide support for managing the following serial data parameters via the Remote Management functionality required herein:
 - Serial data line parameters including baud rate, parity, data and stop bits, and flow control.
 - Network protocol (TCP or UDP) and port number
6. Management
- a. Local Management
 - 1) Provide a command-line interface on the console port.
 - 2) Support configuration via the local management interface of the parameter groups detailed in the following sections:
 - Network Communication
 - Administrative Security
 - b. Remote Management
 - 1) Configuration

- a) Support remote configuration using either the SNMP Agent required herein or a documented and programmatically parsible file accessible for upload and download via embedded FTP or TFTP client, TFTP server, SSH/SCP server, or HTTP server.
 - b) No manufacturer-sourced configuration utilities, applications, or drivers shall be required to configure the encoder.
 - c) Support interactive remote management interface using one or more of the following:
 - Command-line interface via TELNET and/or SSH
 - Embedded HTTP server
 - d) Support configuration of all settings in the following parameter groups via the remote management interface(s).
 - Video Encoding and Streaming
 - Serial Data
 - SNMP Agent
 - SNMP Traps
- 2) SNMP Agent
- a) Provide an SNMPv1 agent accessible on UDP port 161 over the network interface per RFC 1157.
 - b) Support separate configurable read-only and read-write community strings.
 - c) Provide the standard MIB-II objects per RFC 1213.
 - d) Provide the following data in MIB-II object "sysDescr":
 - Manufacturer name
 - Manufacturer model number
 - Manufacturer part number
 - Version identifiers for hardware and firmware components
 - e) Provide the following information via SNMP; using vendor-specific MIB object(s) when necessary:
 - Video Status – whether sync is detected in the video input or not
 - f) Furnish list of all industry standard MIBs that are supported.
 - g) Furnish properly formatted MIB files detailing all vendor-specific objects supported. All MIB files should conform to RFC 1155 and RFC 1212.
 - h) Provide support for managing the following SNMP Agent parameters via both the Local and Remote Management interfaces required herein.
 - Read-only and read-write community strings
- 3) SNMP Traps
- a) Provide support for transmitting SNMPv1 traps over the network interface to UDP port 162 on configured receivers per RFC 1157 and RFC 1215.
 - b) Support a minimum of four (4) configurable trap receivers with corresponding IP addresses and community strings.
 - c) Provide traps reporting changes in the state of the video input sync (i.e. video input sync lost, video input sync restored).
 - d) Furnish list of all industry standard traps that are supported.
 - e) Furnish properly formatted MIB files detailing all vendor-specific trap objects supported. All MIB files should conform to RFC 1155 and RFC 1212.

f) Provide support for managing the following SNMP Trap parameters via both the Local Management and Remote Management interfaces required herein.

- Trap receiver IP addresses and corresponding community strings.

c. Firmware Updates

1) Provide firmware update mechanism via embedded FTP or TFTP client, TFTP server, SSH/SCP server, or HTTP server.

No manufacturer-sourced firmware update utilities, applications, or drivers shall be required to perform firmware updates.

2) Provide password protection for firmware update mechanism or support for enabling and disabling the mechanism if the protocol doesn't support authentication (i.e. embedded TFTP server).

3) Provide support for managing the following firmware update parameters via both the Local Management and Remote Management interfaces required herein.

- Enable/disable insecure firmware update mechanism

d. Administrative Security

1) Provide administrative access control via a configurable password.

2) Provide support for managing the following administrative security parameters via both the Local Management and Remote Management interfaces required herein.

- Administrative password

e. Factory Reset

1) Provide mechanism of resetting the device to a known and documented factory default configuration.

2) Prior knowledge of the current administrative password or current network configuration shall not be necessary to reset the unit to the factory default configuration.

3) Opening the encoder case or enclosure shall not be necessary to reset the unit to the factory default configuration.

f. LED Indicators

Provide separate LED indicators on the exterior of the unit indicating:

- Power
- Video input status (video input sync detected or not detected)
- Network link status and activity

B. Video Encoder, Type C

Video Encoder, Type C is a high density encoder unit for multiple video signals, with one encoder per video signal, suitable for control center use.

1. General

a. Chassis

1) Furnish rack-mountable units.

2) Rack-mountable units shall include integrated brackets for mounting in standard EIA 19-inch rack rack-mountings, and shall be no more than one (1) rack unit (1.75 inches (45 mm)) high and 13 in. (330 mm) deep.

3) High density rack-mountable units are either self-contained, or a card/module-based chassis cage with individual encoders.

4) Furnish a high-density modular chassis cage when card/module-based encoders units are used.

5) High density rack-mountable units shall hold a minimum of eight (8) individual encoders.

- b. Labeling and Identification
 - 1) Provide external silk-screened markings for all connectors, indicators, switches, and replaceable components.
 - 2) Provide external labeling on the front or rear enclosure face for the manufacturer's name, product, model and part numbers, revision numbers, serial number, and MAC address(es).
- c. Environmental
 - 1) Operating temperature of 32 degrees F (0 C) to 113 degrees F (45 C) with relative humidity between 20% to 80% non-condensing.
- d. Power
 - 1) Nominal power input voltage of 120 VAC.
 - 2) If external power supplies are used, they shall fit into the allotted space for the high density unit, and shall meet the same operating temperature and relative humidity requirements.
 - 3) High density unit shall be powered from a single power connection.
- e. Connectors
 - 1) Video Inputs: Multiple BNC connectors with gold-plated center sockets.
 - 2) Network: Single network connection, RJ-45 jack
 - 3) Power: Single power connection, NEMA 5-15 plug
- 2. Interfaces
 - a. Video Inputs: 1 input for each video signal, color NTSC signal, 1 volt peak-to-peak.
 - b. Ethernet
 - 1) IEEE 802.3/802.3u 10/100Mbps Ethernet.
 - 2) Auto-negotiation of speed/duplex operation according to IEEE 802.3ab.
 - 3) High density unit shall be connected with a single network cable connection.
- 3. Network Communication
 - a. Provide a fully functional IP stack and interface, on a per encoder unit or per high density unit basis, that is both standards compliant and consistent with established practices. IP stack must include TCP (per RFC 793), UDP (per RFC 768), IGMPv2 (per RFC 2236), ARP (per RFC 826), ICMP (per RFC 792), SNMP (per RFC 1157), and unicast/broadcast/multicast support.
 - b. Provide statically configurable IP address, subnet netmask, and default gateway.
 - c. Provide support for managing the following network communication parameters via the Local Management functionality required herein.
 - IP Address
 - Subnet Mask
 - Default Gateway
- 4. Video Encoding and Streaming
 - a. For each video input, encode video input using ISO/IEC 14496-2:2004/Amd.2:2005 MPEG-4 Part 2 Simple Profile Level 5 or ISO/IEC 14496-2:2004 MPEG-4 Part 2 Advanced Simple Profile Level 5.
 - b. Support streaming via RTP (per RFC 3550) to configurable unicast or multicast address and port.
 - c. Support configurable multicast time-to-live (TTL) parameter.
 - d. Maintain 4:3 frame aspect ratio.
 - e. Support the following simultaneous settings on all encoder inputs:

- Minimum encoded image resolution of 704x480
 - 30 frames-per-second frame rate
 - I-to-P (group of pictures) ratio of 1:30
 - 4Mbps encoding-bit rate
 - Constant bit rate encoding or constrained variable bit rate encoding
- f. Support access to SDP file (per RFC 4566) matching current stream configuration via HTTP (per RFC2616), RTSP (per RFC 2336), or SAP (per RFC 2974).
 - g. Upon loss of sync on a video input, continue streaming with a solid black image or some indication of “video loss” other than interrupting the stream.
 - h. Any on-screen text or title overlay features shall be configurable to be fully disabled.
 - i. Provide maximum encoding and transmission latency of 300 milliseconds with minimal transmission jitter and no video image degradation or transmission interruptions.
 - j. RTP packet stream’s timestamp is derived from the encoder’s 90KHz clock reference. Reference clock must be synchronized with the actual wall-clock time and the MPEG4 stream, with no noticeable clock drift, for an interval of at least one (1) hour.
 - k. Provide support for managing the following video streaming parameters via the Remote Management functionality required herein.
 - Target address and port
 - TTL parameter
 - Resolution
 - Frame rate
 - I/P ratio
 - Encoding bit rate
 - On-screen text or title overlay features
 - l. Video parameters for each encoder input shall be individually configurable.
 - m. Encoders shall provide a method of reporting video input sync status via an SNMP Agent or HTTP server.
5. Management
- a. Local Management

Provide a command-line or HTTP server interface for configuring the parameter groups detailed in the following sections:

 - Network Communication
 - Administrative Security
 - b. Remote Management
 - 1) Configuration
 - a) Support remote configuration using either the SNMP Agent required herein or a documented and programmatically parsible file accessible for upload and download via embedded FTP or TFTP client, TFTP server, SSH/SCP server, or HTTP server.
 - b) No manufacturer-sourced configuration utilities, applications, or drivers shall be required to configure the encoders.
 - c) Support interactive remote management interface using one or more of the following:
 - Command-line interface via TELNET and/or SSH
 - Embedded HTTP server

- d) Support configuration of all settings in the following parameter groups via the remote management interface(s).
 - Video Encoding and Streaming
 - SNMP Agent
- 2) SNMP Agent
 - a) Provide an SNMPv1 agent accessible on UDP port 161 over the network interface per RFC 1157.
 - b) Support separate configurable read-only and read-write community strings.
 - c) Provide the standard MIB-II objects per RFC 1213.
 - d) Provide the following data in MIB-II object "sysDescr":
 - Manufacturer name
 - Manufacturer model number
 - Manufacturer part number
 - Version identifiers for hardware and firmware components
 - e) Furnish list of all industry standard MIBs that are supported.
 - f) Furnish properly formatted MIB files detailing all vendor-specific objects supported. All MIB files should conform to RFC 1155 and RFC 1212.
 - g) Provide support for managing the following SNMP Agent parameters via both the Local and Remote Management interfaces required herein.
 - Read-only and read-write community strings
- c. Firmware Updates
 - 1) Provide firmware update mechanism via embedded FTP or TFTP client, TFTP server, SSH/SCP server, or HTTP server.
 - 2) No manufacturer-sourced firmware update utilities, applications, or drivers shall be required to perform firmware updates.
 - 3) Provide password protection for firmware update mechanism or support for enabling and disabling the mechanism if the protocol doesn't support authentication (i.e. embedded TFTP server).
 - 4) Provide support for managing the following firmware update parameters via both the Local Management and Remote Management interfaces required herein.
 - Enable/disable insecure firmware update mechanism
- d. Administrative Security
 - 1) Provide administrative access control via a configurable password.
 - 2) Provide support for managing the following administrative security parameters via both the Local Management and Remote Management interfaces required herein.
 - Administrative password
- e. Factory Reset
 - 1) Provide mechanism of resetting the device to a known and documented factory default configuration.
 - 2) Prior knowledge of the current administrative password or current network configuration shall not be necessary to reset the unit to the factory default configuration.
 - 3) Opening the encoder case or enclosure shall not be necessary to reset the unit to the factory default configuration.
- f. LED Indicators

Provide separate LED indicators on the exterior of the unit indicating:

- Power
- Network link status and activity

939.2.10 Video Decoder (All Types)

A. Video Decoder, Type B

Video Decoder, Type B is a standalone decoder for a single RTP video stream, suitable for dedicated point-to-point analog video transport links, or viewing encoded video on a single monitor.

1. General

a. Chassis

- 1) Furnish rack-mountable or shelf-mountable units.
- 2) Rack-mountable units shall include integrated brackets for mounting in standard EIA 19-inch rack rack-mountings, and shall be no more than one (1) rack unit (1.75 inches (45 mm)) high and 13 in. (330 mm) deep.
- 3) Shelf-mountable units shall be no more than 3.5 in. (89 mm) (H) x 9 in. (229 mm) (W) x 11 in. (280 mm) (D), and shall include a perforated ventilated shelf for mounting in a standard EIA 19-inch rack, no more than 13 inches (330 mm) deep with mounting flanges of two (2) rack units (3.5 in. (89 mm)) and a minimum 20 lb (9 kg) load rating.

b. Labeling and Identification

- 1) Provide external silk-screened markings for all connectors, indicators, switches, and replaceable components.
- 2) Provide external labeling on the front or rear enclosure face for the manufacturer's name, product, model and part numbers, revision numbers, serial number, and MAC address.

c. Environmental

- 1) Operating temperature of -30 degrees F (-34 C) to 165 degrees F (74 C) with relative humidity between 10% to 90% non-condensing.
- 2) Ventilation fans are not permitted.

d. Power

- 1) Nominal power input voltage of 120 VAC.
- 2) Maximum power consumption of 20 watts.
- 3) If external power supplies are used, they shall fit into the allotted space for the decoder, and shall meet the same operating temperature and relative humidity requirements.

e. Connectors

- 1) Video Output: BNC connector with gold-plated center socket.
- 2) Network: RJ-45 jack
- 3) Console: Female 9-pin D-subminiature (DE-9F) connector for RS-232 DCE (data circuit equipment) console interface compliant with TIA-574. If decoder housing has a connector interface other than DE-9F, furnish an adapter cable (no greater than 1m in length) with the required DE-9F connector for each decoder and labeled "CONSOLE".
- 4) Power: NEMA 5-15 plug

2. Interfaces

- a. Video Output: Color NTSC signal, 1 volt peak-to-peak.
- b. Console: RS-232 operation for PC communications.

- c. Ethernet
 - 1) IEEE 802.3/802.3u 10/100Mbps Ethernet.
 - 2) Auto-negotiation of speed/duplex operation according to IEEE 802.3ab.
3. Network Communication
- a. Provide a fully functional IP stack and interface that is both standards compliant and consistent with established practices. IP stack must include TCP (per RFC 793), UDP (per RFC 768), IGMPv2 (per RFC 2236), ARP (per RFC 826), ICMP (per RFC 792), SNMP (per RFC 1157), and unicast/broadcast/multicast support.
 - b. Provide statically configurable IP address, subnet netmask, and default gateway.
 - c. Provide support for managing the following network communication parameters via the Local Management functionality required herein.
 - IP Address
 - Subnet Mask
 - Default Gateway
4. Video Decoding and Streaming
- a. For each video output, decode video streams that are compliant to all of the following ISO/IEC 14496-2:2004/Amd.2:2005 MPEG-4 Part 2 profiles:
 - Simple Profile Level 0 (QCIF)
 - Simple Profile Level 1 (QCIF)
 - Simple Profile Level 2 (CIF)
 - Simple Profile Level 3 (CIF)
 - Simple Profile Level 5 (D1)
 - Advanced Simple Profile Level 0 (QCIF)
 - Advanced Simple Profile Level 1 (QCIF)
 - Advanced Simple Profile Level 2 (CIF)
 - Advanced Simple Profile Level 3 (CIF)
 - Advanced Simple Profile Level 4 (CIF)
 - Advanced Simple Profile Level 5 (D1)
 - b. Support streaming via RTP (per RFC 3550) to configurable unicast or multicast address and port.
 - c. Maintain 4:3 frame aspect ratio.
 - d. Support for the following resolutions, scaled to the proper aspect ratio:
 - D1 (720x480)
 - 4CIF (704x480)
 - CIF (352x240)
 - QCIF (176x120, 176x112, 160x120, 160x112)
 - e. Support the following simultaneous capabilities on the decoder output:
 - 30 frames-per-second frame rate
 - I-to-P (group of pictures) ratio from 1:1 to 1:30
 - Up to 4Mbps encoding bit rate
 - Automatic adjustment to stream format changes

- Switch between RTP streams on different addresses and port numbers and resynchronize with the new stream within 3 I-frames.
- f. Upon loss of video stream, output an indication in the video image that the video stream was lost.
 - g. Any on-screen text or title overlay features shall be configurable to be fully disabled.
-
- h. Provide maximum decoding latency of 300 milliseconds with minimal transmission jitter and no video image degradation or transmission interruptions.
 - i. Decoded video must remain synchronized with the RTP packet stream with no noticeable drift for an interval of at least one (1) hour. RTP packet stream is derived from a 90 KHz clock reference.
 - j. Provide support for managing the following video streaming parameters via the Remote Management functionality required herein.
 - Unicast or multicast stream selection
 - Target address (for multicast sources)
 - Target port
5. Management
 - a. Local Management
 - 1) Provide a command-line interface on the console port.
 - 2) Support configuration via the local management interface of the parameter groups detailed in the following sections:
 - Network Communication
 - Administrative Security
 - b. Remote Management
 - 1) Configuration
 - a) Support remote configuration using either the SNMP Agent required herein or a documented and programmatically parsible file accessible for upload and download via embedded FTP or TFTP client, TFTP server, SSH/SCP server, or HTTP server.
 - b) No manufacturer-sourced configuration utilities, applications, or drivers shall be required to configure the decoder.
 - c) Support interactive remote management interface using one or more of the following:
 - Command-line interface via TELNET and/or SSH
 - Embedded HTTP server
 - d) Support configuration of all settings in the following parameter groups via the remote management interface(s).
 - Video Decoding and Streaming
 - SNMP Agent
 - SNMP Traps
 - 2) SNMP Agent
 - a) Provide an SNMPv1 agent accessible on UDP port 161 over the network interface per RFC 1157.
 - b) Support separate configurable read-only and read-write community strings.
 - c) Provide the standard MIB-II objects per RFC 1213.
 - d) Provide the following data in MIB-II object "sysDescr":
 - Manufacturer name

- Manufacturer model number
 - Manufacturer part number
 - Version identifiers for hardware and firmware components
- e) Furnish list of all industry standard MIBs that are supported.
 - f) Furnish properly formatted MIB files detailing all vendor-specific objects supported. All MIB files should conform to RFC 1155 and RFC 1212.
 - g) Provide support for managing the following SNMP Agent parameters via both the Local and Remote Management interfaces required herein.
 - Read-only and read-write community strings
- 3) SNMP Traps
- a) Provide support for transmitting SNMPv1 traps over the network interface to UDP port 162 on configured receivers per RFC 1157 and RFC 1215.
 - b) Support a minimum of four (4) configurable trap receivers with corresponding IP addresses and community strings.
 - c) Provide traps reporting changes in the state of the video input sync (i.e. video input sync lost, video input sync restored).
 - d) Furnish list of all industry standard traps that are supported.
 - e) Furnish properly formatted MIB files detailing all vendor-specific trap objects supported. All MIB files should conform to RFC 1155 and RFC 1212.
 - f) Provide support for managing the following SNMP Trap parameters via both the Local Management and Remote Management interfaces required herein.
 - Trap receiver IP addresses and corresponding community strings.
- c. Firmware Updates
- 1) Provide firmware update mechanism via embedded FTP or TFTP client, TFTP server, SSH/SCP server, or HTTP server.
 - 2) No manufacturer-sourced firmware update utilities, applications, or drivers shall be required to perform firmware updates.
 - 3) Provide password protection for firmware update mechanism or support for enabling and disabling the mechanism if the protocol doesn't support authentication (i.e. embedded TFTP server).
 - 4) Provide support for managing the following firmware update parameters via both the Local Management and Remote Management interfaces required herein.
 - Enable/disable insecure firmware update mechanism
- d. Administrative Security
- 1) Provide administrative access control via a configurable password.
 - 2) Provide support for managing the following administrative security parameters via both the Local Management and Remote Management interfaces required herein.
 - Administrative password
- e. Factory Reset
- 1) Provide mechanism of resetting the device to a known and documented factory default configuration.
 - 2) Prior knowledge of the current administrative password or current network configuration shall not be necessary to reset the unit to the factory default configuration.

- 3) Opening the decoder case or enclosure shall not be necessary to reset the unit to the factory default configuration.
- f. LED Indicators

Provide separate LED indicators on the exterior of the unit indicating:

- Power
- Video stream status (video stream detected or not detected)
- Network link status and activity

B. Video Decoder, Type C

Video Decoder, Type C is a high density decoder unit to decode multiple RTP video streams and display them on analog video outputs, with one output per video stream, suitable for control center use.

1. General

a. Chassis

- 1) Furnish rack-mountable units.
- 2) Rack-mountable units shall include integrated brackets for mounting in standard EIA 19-inch rack rack-mountings, and shall be no more than five (5) rack units (8.75 inches (223 mm)) high and 13 in. (330 mm) deep.
- 3) High density rack-mountable units are either self-contained, or a card/module-based chassis cage with individual decoders.
- 4) Furnish a high-density modular chassis cage when card/module-based decoder units are used.
- 5) High density rack-mountable units shall hold a minimum of twelve (12) individual decoders.

b. Labeling and Identification

- 1) Provide external silk-screened markings for all connectors, indicators, switches, and replaceable components.
- 2) Provide external labeling on the front or rear enclosure face for the manufacturer's name, product, model and part numbers, revision numbers, serial number, and MAC address(es).

c. Environmental

- 1) Operating temperature of 32 degrees F (0 C) to 113 degrees F (45 C) with relative humidity between 20% to 80% non-condensing.

d. Power

- 1) Nominal power input voltage of 120 VAC.
- 2) If external power supplies are used, they shall fit into the allotted space for the high density unit, and shall meet the same operating temperature and relative humidity requirements.
- 3) High density unit shall be powered from a single power connection.

e. Connectors

- 1) Video Outputs: Multiple BNC connectors with gold-plated center sockets.
- 2) Network: Single or multiple network connection(s), RJ-45 jack(s)
- 3) Console: Single or multiple console ports using female 9-pin D-subminiature (DE-9F) connector for RS-232 DCE (data circuit equipment) console interface compliant with TIA-574. If encoder housing has a connector interface other than DE-9F, furnish an adapter cable (no greater than 1m in length) with the required DE-9F connector for each encoder and labeled "CONSOLE".
- 4) Power: Single power connection, NEMA 5-15 plug

2. Interfaces

- a. Video Outputs: 1 output for each video signal, color NTSC signal, 1 volt peak-to-peak.
 - b. Console: RS-232 operation for PC communications.
 - c. Ethernet
 - 1) IEEE 802.3/802.3u 10/100Mbps Ethernet.
 - 2) Auto-negotiation of speed/duplex operation according to IEEE 802.3ab.
3. Network Communication
- a. Provide a fully functional IP stack and interface, on a per decoder unit or per high density unit basis, that is both standards compliant and consistent with established practices. IP stack must include TCP (per RFC 793), UDP (per RFC 768), IGMPv2 (per RFC 2236), ARP (per RFC 826), ICMP (per RFC 792), SNMP (per RFC 1157), and unicast/broadcast/multicast support.
 - b. Provide statically configurable IP address, subnet netmask, and default gateway.
 - c. Provide support for managing the following network communication parameters via the Local Management functionality required herein.
 - IP Address
 - Subnet Mask
 - Default Gateway
4. Video Decoding and Streaming
- a. For each video output, decode video streams that are compliant to all of the following ISO/IEC 14496-2:2004/Amd.2:2005 MPEG-4 Part 2 profiles:
 - Simple Profile Level 0 (QCIF)
 - Simple Profile Level 1 (QCIF)
 - Simple Profile Level 2 (CIF)
 - Simple Profile Level 3 (CIF)
 - Simple Profile Level 5 (D1)
 - Advanced Simple Profile Level 0 (QCIF)
 - Advanced Simple Profile Level 1 (QCIF)
 - Advanced Simple Profile Level 2 (CIF)
 - Advanced Simple Profile Level 3 (CIF)
 - Advanced Simple Profile Level 4 (CIF)
 - Advanced Simple Profile Level 5 (D1)
 - b. Support RTP (per RFC 3550) stream decoding from configurable unicast port, or multicast address and port.
 - c. Maintain 4:3 frame aspect ratio.
 - d. Support for the following resolutions, scaled to the proper aspect ratio:
 - D1 (720x480)
 - 4CIF (704x480)
 - CIF (352x240)
 - QCIF (176x120, 176x112, 160x120, 160x112)
 - e. Support the following simultaneous capabilities on all decoder outputs:
 - Up to 30 frames-per-second frame rate
 - I-to-P (group of pictures) ratio from 1:1 to 1:30

- Up to 4Mbps encoding bit rate
 - Automatic adjustment to stream format changes
 - Switch between RTP streams on different addresses and port numbers and resynchronize with the new stream within 3 I-frames.
-
- f. Upon loss of video stream, output an indication in the video image that the video stream was lost.
 - g. Any on-screen text or title overlay features shall be configurable to be fully disabled.
 - h. Provide maximum decoding latency of 300 milliseconds with minimal transmission jitter and no video image degradation or transmission interruptions.
 - i. Decoded video must remain synchronized with the RTP packet stream with no noticeable drift for an interval of at least one (1) hour. RTP packet stream is derived from a 90KHz clock reference.
 - j. Provide support for managing the following video streaming parameters via the Remote Management functionality required herein.
 - Unicast or multicast stream selection
 - Target address (for multicast sources)
 - Target port
 - k. Video parameters for each decoder shall be individually configurable.
5. Management
- a. Local Management
 - 1) Provide a command-line interface on the console port.
 - 2) Support configuration via the local management interface of the parameter groups detailed in the following sections:
 - Network Communication
 - Administrative Security
 - b. Remote Management
 - 1) Configuration
 - a) Support remote configuration using either the SNMP Agent required herein or a documented and programmatically parsible file accessible for upload and download via embedded FTP or TFTP client, TFTP server, SSH/SCP server, or HTTP server.
 - b) No manufacturer-sourced configuration utilities, applications, or drivers shall be required to configure the decoders.
 - c) Support interactive remote management interface using one or more of the following:
 - Command-line interface via TELNET and/or SSH
 - Embedded HTTP server
 - d) Support configuration of all settings in the following parameter groups via the remote management interface(s).
 - Video Decoding and Streaming
 - SNMP Agent
 - SNMP Traps
 - 2) SNMP Agent
 - a) Provide an SNMPv1 agent accessible on UDP port 161 over the network interface per RFC 1157.
 - b) Support separate configurable read-only and read-write community strings.

- c) Provide the standard MIB-II objects per RFC 1213.
 - d) Provide the following data in MIB-II object "sysDescr":
 - Manufacturer name
 - Manufacturer model number
 - Manufacturer part number
 - Version identifiers for hardware and firmware components
 - e) Furnish list of all industry standard MIBs that are supported.
 - f) Furnish properly formatted MIB files detailing all vendor-specific objects supported. All MIB files should conform to RFC 1155 and RFC 1212.
 - g) Provide support for managing the following SNMP Agent parameters via both the Local and Remote Management interfaces required herein.
 - Read-only and read-write community strings
- 3) SNMP Traps
- a) Provide support for transmitting SNMPv1 traps over the network interface to UDP port 162 on configured receivers per RFC 1157 and RFC 1215.
 - b) Support a minimum of four (4) configurable trap receivers with corresponding IP addresses and community strings.
 - c) Provide traps reporting changes in the state of the video input sync (i.e. video input sync lost, video input sync restored).
 - d) Furnish list of all industry standard traps that are supported.
 - e) Furnish properly formatted MIB files detailing all vendor-specific trap objects supported. All MIB files should conform to RFC 1155 and RFC 1212.
 - f) Provide support for managing the following SNMP Trap parameters via both the Local Management and Remote Management interfaces required herein.
 - Trap receiver IP addresses and corresponding community strings.
- c. Firmware Updates
- 1) Provide firmware update mechanism via embedded FTP or TFTP client, TFTP server, SSH/SCP server, or HTTP server.
 - 2) No manufacturer-sourced firmware update utilities, applications, or drivers shall be required to perform firmware updates.
 - 3) Provide password protection for firmware update mechanism or support for enabling and disabling the mechanism if the protocol doesn't support authentication (i.e. embedded TFTP server).
 - 4) Provide support for managing the following firmware update parameters via both the Local Management and Remote Management interfaces required herein.
 - Enable/disable insecure firmware update mechanism
- d. Administrative Security
- 1) Provide administrative access control via a configurable password.
 - 2) Provide support for managing the following administrative security parameters via both the Local Management and Remote Management interfaces required herein.
 - Administrative password
- e. Factory Reset
- 1) Provide mechanism of resetting the device to a known and documented factory default configuration.

- 2) Prior knowledge of the current administrative password or current network configuration shall not be necessary to reset the unit to the factory default configuration.
- 3) Opening the encoder case or enclosure shall not be necessary to reset the unit to the factory default configuration.

f. LED Indicators

Provide separate LED indicators on the exterior of the unit indicating:

- Power
- Video stream status (video stream detected or not detected)
- Network link status and activity

939.2.11 Equipment Rack

Provide equipment racks as applicable and required within the equipment cabinets as specified herein.

939.2.12 Equipment Frame

Provide equipment frames meeting the following requirements:

- Overall dimensions of approximately 84" (210 mm) high by 20.25" (514.4 mm) wide and meeting EIA standards for mounting 19" (480 mm) equipment.
- Equipment frame upright channels fabricated from 6061-T6 aluminum extrusions with minimum depth of 5.75" (146 mm), flange thickness of 0.19" (4.8 mm) and web thickness of 0.16" (4.1 mm).
- Fully assembled frames, with all mounting and accessories as required herein, that comply with Telcordia GR-63-CORE Network Equipment Building System Seismic Zone Rating 4..
- Equipment frame upright channels manufactured with threaded #12-24 mounting holes of entire channel length front and rear with standard EIA spacing. Do not use non-threaded clearance holes with separate "clip nuts".
- Provide front and rear mounting base angles fabricated from 6061-T6 aluminum extrusions with minimum 6" (150 mm) footing extension. Secure base angles to floor with a minimum of four 0.625 threaded expansion anchor bolts with steel or brass expansion sleeves. Do not use any other type of anchor.
- Provide front and rear top angles fabricated from 6061-T6 aluminum extrusions with minimum 1.5" (38 mm) by 2.0" (51 mm) web.
- Provide a front-mounted lower guard-rail fabricated from minimum 0.25" (6.4 mm) by 2.0" (51 mm) bar stock with 6.0" (150 mm) to 7.0" (180 mm) standoff from the upright channel.

Provide vertical cable management ducts in between all equipment frames and at each end of a row of equipment frames. Provide a vertical cable management duct on each side of a single equipment frame. Use vertical cable management ducts that reach from the bottom of the equipment frame fully to the top of the frame and that connect with the cable (fiber optic jumper) management ducts installed in the hub's cable runways. Use ducts that are double-sided, opening to the front and rear of the equipment frames, with each side having the minimum inside dimensions of 3.5" (89 mm) wide by 6.25" (159 mm) deep. Provide plastic or rubber grommets openings, between the two sides of the duct, with a minimum opening of 2" (50 mm) and a maximum spacing of 12" (300 mm). On the front-opening of each side of the duct, provide positive cable restraint through opening latches or removable covers.

- For all assembly or fastening hardware use zinc-plated steel, nickel-plated brass, or stainless steel unless otherwise specified.
- Use a black color finish on upright channels, top and base angles, and lower guard rails.
- With each equipment frame provide a minimum of 50 #12-24 x 0.75" (19 mm) (minimum) cuphead phillips-slot mounting screws with pilot points and nylon washers. Use zinc-plated steel, nickel-plated brass, or stainless steel screws. Provide more screws if necessary to properly mount all equipment as shown in the Plans.

- Provide a rear-mounted, 20-amp, 10-receptacle power strip secured with a minimum of four rigid standoff brackets. Do not use threaded bolts or rods as standoff brackets.
- Provide a sliding drawer that is an aluminum storage compartment mounted in each frame with the approximate following dimensions: 1.75 in (44.4 mm) (H) x 16 in (410 mm) (W) x 14 in (360 mm) (D). Ensure the compartment has telescoping drawer guides to allow full extension from the equipment frame upright channels. When extended, the storage compartment shall open to provide storage space for documentation and other miscellaneous items. The sliding drawer/storage compartment shall be of adequate construction to support a weight of 25 lb (11 kg) when extended. The top of the storage compartment shall have a non-slip plastic laminate attached which covers a minimum of 90% of the surface area of the top.
- Perform all assembly and installation in accordance with the equipment frame manufacturer's recommendations.

939.2.13 Dial-up Modem

As required, furnish and ensure that the dial-up modems are stand-alone modems that support programmable communication rates of 0-56,000 bps and provide fully automatic communications rate selection. Provide modems meeting the following minimum specifications:

- Modulation: V.34, V.90, V.32
- Protocol: Asynchronous and synchronous supported
- Error control: V.42
- Hayes standard AT command set
- Automatic speed buffering
- Flow control
- (2) Modular RJ-11 telephone line connectors
- Modular DB-25 RS-232C serial interface connector
- LED indicators for TX, RX, RTS, DCD, PWR

A. Equipment Cabinet Assembly

Ensure that all cabinets exhibit a smooth, uniform natural aluminum finish.

All bolts, nuts, washers, screws, hinges and hinge pins shall be stainless steel.

Manufacture the exterior mounting bracket and fixtures of aluminum or galvanized steel, and manufacture all fastening and mounting hardware of stainless steel. Verify that the bottom of the pole-mounted cabinet is fully enclosed. Where base-mounting of equipment cabinets is specified, the cabinet bottom shall be open.

Verify that all electrical cables between the cabinet and the device are UL-listed tray cable with #18 AWG 16-strand copper conductors with PVC/nylon insulation and a UV-resistant PVC outer jacket rated for 600V, 190 F (90 C) dry, 170 F (75 C) wet and wet/dry direct burial use. Conductor color-coding shall be in accordance with ICEA Table K.2/Method 1.

1. General

a. Standard Cabinet Housing

- 1) General Requirements: Unless otherwise specified, furnish cabinet housings that conform to the Cabinet Housing Details as defined in Chapter 6, Sections 2, 3 and 5 and the Cabinet Housing Details of the Caltrans Traffic Signal Control Equipment Specification, latest version (TSCES). The police panel and associated wiring circuits are not required as part of this cabinet assembly. All cabinets shall have hooks, welded to the inside of the front cabinet door, for hanging the plastic documentation pouch.
- 2) Unless otherwise specified in these Special Provisions or in the Plans, configure all equipment cabinet assemblies for pole mounting. The holes for pole mounting shall be properly reinforced with metal plates of adequate size and strength welded longitudinally across the inside depth of the cabinet. Where base-

mounting of equipment cabinets is specified, make the cabinet bottom open and provide an approved base mounting adapter, in accordance with the Department's Standard Specification for Traffic Signal Equipment.

- b. Type A Standard Cabinet Housing – Not Applicable
- c. Type B Standard Cabinet Housing – Not Applicable
- d. Type C Standard Cabinet Housing:
 - 1) The Type C cabinet housing (see Detail Drawings) is a standard Model 332 housing with approximate exterior dimensions of 64 in. (1.6 m) (H) x 24 in. (0.61 m) (W) x 30 in. (0.76 m) (D).
 - 2) Equip all Type C cabinet housings with the standard EIA 19-inch rack cabinet cage as described in Section 3 of the Caltrans specification. Install side panels within the two sides of the cabinet cage as shown on the Detail Drawings in this section. Each side panel shall be fabricated from 5052 sheet aluminum alloy with a minimum thickness of 0.125 in (3.175 mm).
 - 3) Equip Type C cabinet housings with a cabinet sliding drawer. Follow the drawer specifications given in Subsection 939.2.B.5.
 - 4) Provide a ground fault interrupt 15A duplex receptacle (NEMA 5-15R) in the cabinet as an accessory outlet. Install two (2) non-ground fault protected 15A equipment outlet strips, each with ten (10) receptacles. Mount the strip outlets vertically near the top of the cabinet as shown in the Detail Drawings in this section.
- e. Type D Standard Cabinet Housing:
 - 1) The Type D cabinet housing shall be a standard Model 336 stretch (336S) housing with approximate exterior dimensions of 46 in. (1.2 m) (H) x 24 in. (0.61 m) (W) x 23 in. (0.58 m) (D). The minimum door opening dimensions shall be 40.5 in. (1.03 m) (H) x 22 in. (0.56 m) (W).
 - 2) Equip all Type D cabinet housings with the standard EIA 19-inch rack cabinet cage as described in Section 3 of the Caltrans specifications and mounting panels as shown on the Detail Drawings in this section. The
 - 3) minimum clear vertical inside dimension of the rack for equipment mounting shall be 39.5 in. (1.00 m). Install side panels within the two sides of the cabinet cage. Use side panels fabricated from 5052 sheet aluminum alloy with a minimum thickness of 0.125 in (3.175 mm).
 - 4) Equip the Type D cabinet housing with a cabinet-sliding drawer. Follow the drawer specifications given in Subsection 939.2.B.5.
 - 5) Provide a ground fault interrupt 15A duplex receptacle (NEMA 5-15R) in the cabinet as an accessory outlet. Provide rack mounted power strip outlets near the top of the cabinet as shown in the Detail Drawings in this section. The power strip shall incorporate eight (8) NEMA 5-15R receptacles. The power strip receptacle shall face the back of the cabinet and shall be recessed within the cabinet rack to provide a minimum spacing of three (3) inches between the outlet's face and the cabinet door when the door is closed.
- f. Type F Standard Cabinet Housing:
 - 1) The Type F cabinet housing shall be a standard ITS Cabinet Housing #3 with approximate exterior dimensions of 67 in. (1.7 m) (H) x 44 in. (1.2 m) (W) x 26 in. (0.66 m) (D) as specified in the Caltrans Transportation Electrical Equipment Specifications, latest version and all addenda (TEES). The minimum door opening dimensions shall be 56 in. (1.4 m) (H) x 20 in. (0.51 m) (W).
 - 2) Equip all Type F cabinet housings with two standard EIA 19-inch rack cabinet cages as described in the Caltrans TEES. Equip all Type F cabinet housing with four (4) side mounting panels in the rack cabinet cages; side mounting panels shall mount from inside the rack cabinet cage only. The minimum clear vertical inside dimension of the rack for equipment mounting shall be 54.5 in. (1.4 m). Use side panels fabricated from 5052 sheet aluminum alloy with a minimum thickness of 0.125 in (3.175 mm) with minimum dimensions of 50 in (1.3 m) (H) x 21 in. (0.53 m) (W).
 - 3) Provide a minimum of four (4) wiring pass-through holes on the inside mounting panels to permit patch cords to pass between the two cabinet sides. Each pass-through hole shall be 5 in. (127 mm) in diameter

and shall be fully grommetted for patch cord protection, with the holes positioned with two (2) in the cabinet front and two (2) in the cabinet rear and aligning horizontally between the two side panels.

- 4) Provide a minimum of 16 plastic- or rubber-coated J-hooks or D-rings, minimum 1 in. (25 mm) depth and height, on the inside rails of the rack cabinet cages, to organize patch cords passing between the two cabinet sides. Install the J-hooks in horizontally-aligned pairs on the inside rails, with four (4) pairs in the cabinet front and four (4) pairs in the cabinet rear.
- 5) Equip the Type F cabinet housing with two cabinet-sliding drawers. Follow the drawer specifications given in Subsection 939.2.B.5.
- 6) Provide a ground fault interrupt 15A duplex receptacle (NEMA 5-15R) in the cabinet as an accessory outlet. Provide rack mounted power strip outlets near the top of the cabinet as shown in the Detail Drawings in this section. The power strip shall incorporate eight (8) NEMA 5-15R receptacles. The power strip receptacle shall face the back of the cabinet and shall be recessed within the cabinet rack to provide a minimum spacing of 3 in. (76 mm) between the outlet's face and the cabinet door when the door is closed.

2. Internal Cabinet Assembly Components

- a. Unless otherwise specified in the Plans or approved by the Engineer, construct all cabinet assemblies in conformance with this Subsection 939.2.B including all Detail Drawings, all applicable provisions of the Georgia DOT Standard Specifications for Traffic Signal Equipment, and applicable provisions of the Caltrans TSCES or TEES. Do not include with the cabinet assembly the power supply assembly, power distribution assembly, input file, output file, monitor unit assembly, field terminal hookup blocks, modular/serial/control bus, AC/DC power assembly and extension, and related wiring assemblies as described in the Caltrans TSCES or TEES.
- b. Provide a plastic documentation pouch to store the cabinet and equipment documentation. Use a pouch that is side-opening, resealable, opaque, and of a heavy-duty plastic material. Use a pouch that has metal or

hard-plastic reinforced holes for hanging from hooks included on the cabinet door. The pouch shall be of the size and strength to easily hold all wiring diagrams, equipment documentation and the maintenance logbook

3. Wiring, Conductors and Terminal Blocks

All 120VAC service entrance, power distribution, grounding and protection shall be provided by components mounted on 35mm DIN standard rails. Devices include, terminal blocks, circuit breakers and surge protection devices. All DIN rail mounted components will be certified to meet or exceed UL-94, UL-467, UL-489, UL-1449, IEC-947-7-1, IEC-60947-2, CSA-22.2 or as specified in the Details or special provisions.

DIN rail mounted power distribution devices supplied shall be configured as shown in the Details and shall meet or exceed the specifications and certifications listed below.

a. Mounting Rail

Use DIN rail fabricated from galvanized passivated steel with prepunched holes for mounting and certified to meet EN 50022, EN 60715 and DIN 46277-3. DIN mounting rail shall be 35mm wide, 7.5 mm high, 1 mm thick, perforated for flexible mounting and cut to length as show in the Details. Rail will cut between mounting holes to allow mounting at both ends of the rail section. Rail shall be provided burr free with no sharp edges or deformation from the standard profile. The portion of the rail at the mounting bolt holes shall be cleaned of any coating to expose the underlying steel. The area under the bolt hole and the aluminum power panel mounting point shall be covered with an anti corrosion paste to provide a solid and long lasting electrical connection between the DIN Rail and the power panel. DIN Rail shall be attached to the power panel by nut and bolt with star washers to provide a low resistance electrical connection between the rail and the power panel.

b. Terminal Blocks

Use DIN terminal blocks with voltage and current ratings greater than the voltage and current ratings of the wires that are terminated on the blocks. Metallic terminal block connection hardware and components shall be non-ferrous copper or nickel/tin-plated copper alloy or equivalent. All terminal blocks and wire shall be supplied in the colors listed below (see Detail Drawings).

- Black – Line
- White – Neutral

- Green or Green/Yellow – Ground
- c. Service Entrance Terminal Blocks
- Make the terminal block for the 120VAC cabinet service entrance (SE) a 10 mm single level screw type device. The terminal block shall accommodate #20 - 6 AWG wiring and shall be provided in colors as specified herein. The Ground terminal shall be the same size and pitch as the power terminals and shall provide positive electrical and mechanical connection to the mounting rail. Ground terminals may be provided in the color green or the international green and yellow style. Provide the quantity of terminals as shown in the Details.
- d. Distribution Terminal Blocks
- Terminal blocks for distribution of 120 VAC (TB2) and ground located on the protected side of the power distribution assembly shall be a 6 mm single level screw type device. The terminal block shall accommodate #24-8 AWG wiring and shall be provided in colors as specified herein. The Ground terminal shall be the same size and pitch as the power terminals and shall provide positive electrical and mechanical connection to the mounting rail. Ground terminals may be provided in the color green or the international green and yellow style. Provide the quantity of terminals as shown in the Details.
- e. Cross Connection Bridge
- Cross connection bridge strips shall be provided to connect a number of terminal blocks to create the specified power distribution design. The bridge strips shall match the pitch and construction of the terminals to be connected and shall be certified by the terminal block manufacturer to be compatible with the connected terminal blocks. Cross connection bridge strips shall be fully insulated to prevent operator contact. Connected terminal blocks of any number shall be connected by a single cross connection bridge strip.
- f. Circuit Breaker
- Provide circuit breakers as shown in the Detail Drawings in this section. Use only circuit breakers that are UL-489 and CSA 22.2 approved and plainly marked with trip, frame sizes and ampere rating. All circuit breakers shall be quick-make, quick-break on either automatic or manual operation. Ensure that contacts are silver alloy and enclosed in an arc-quenching chamber. Overload tripping shall not be influenced by an ambient air temperature range from -18 degrees C to 50 degrees C. Minimum interrupting capacity shall be 5,000 amperes RMS. Use only circuit breakers that are 35 mm DIN rail mounted.
- g. End Brackets
- Provide screw-clamped end brackets to positively lock all DIN rail mounted devices to the rail.
- h. Spacer
- Spacers or dividers shall be placed between terminal blocks and other components as shown in the Details for visual separation. Spacers shall snap on to DIN rail be approximately 5-18 mm thick and match the size of the terminals they separate.
- i. Safety Cover
- A safety covers shall be provided on terminal blocks to prevent contact with exposed conductors or any metallic components. This cover will provide electrical and visual separation between terminal blocks and other rail mounted devices. Covers shall be approximately 2mm thick and sized to match the terminal blocks they protect or separate.
- j. Surge Suppressor
- Provide a DIN rail mounted TVSS (Transient Voltage Surge Suppressor) with RFI/EMI filtering for AC power service to the cabinet housing. The TVSS shall provide protection from all conductors to ground and meet or exceed the following requirements and levels of protection.
- Nominal operating Voltage 120 V
 - Max. Continuous Operating Voltage 150V
 - Max. Surge Current Rating 20 kA
 - Nominal Surge Current Rating for 8x20µs surge 20 kA
 - Internal Thermal Fuses
 - Failure/ replacement indication

- Operating Temperature: -40C to 80C
- Meet UL1449 2nd Ed.,
- VDE0675-6, CSA-22.2, and CE marked

k. Wiring

Use a minimum #12 AWG grounding of each surge suppression device, or larger if recommended by the surge suppression device manufacturer or indicated in the Details. Use insulated green wire and connect the ground wire directly to the ground terminals. Do not “daisy chain” with the grounding wires of other devices including other surge suppressors. Terminate all ground wiring between cabinet surge suppressor devices on the DIN rail mounted ground terminal blocks. Dress and route grounding wires separately from all other cabinet wiring. Install grounding wires with the absolute minimum length possible between the suppressor and the ground terminals. Label all surge suppressors with silk-screened lettering on the mounting panel. Use minimum #12 AWG insulated THHN-THWN conductors between the surge suppression device and the power distribution terminal.

4. Sliding Drawer

Install drawer that is an aluminum storage compartment mounted in the rack assembly with the approximate following dimensions: 1.75 in (44.4 mm) (H) x 16 in (410 mm) (W) x 14 in (360 mm) (D). Ensure the compartment has telescoping drawer guides to allow full extension from the rack assembly. When extended, the storage compartment shall open to provide storage space for cabinet documentation and other miscellaneous items. Install a storage compartment that is of adequate construction to support a weight of 25 lb (11 kg) when extended. The top of the storage compartment shall have a non-slip plastic laminate attached which covers a minimum of 90% of the surface area of the top.

939.2.02 Delivery, Storage and Handling - Not applicable

939.3 Construction Requirements

939.3.01 Personnel

Have trained personnel available for troubleshooting and problem solving until all equipment is fully functional and ready to start the acceptance phase.

939.3.02 Equipment - Not applicable

939.3.03 Preparation

A. Network Equipment Programming

Perform network equipment programming and testing in accordance with the Network Equipment Programming Procedure below and as directed by the Engineer. Network equipment is defined as any traffic control and monitoring equipment with an Ethernet interface and includes equipment from the following GDOT Specifications and Special Provisions:

- Section 631—Changeable Message Signs
- Section 925—Traffic Signal Equipment
- Section 937—Video Detection System
- Section 938—Detection
- Section 939—Communications & Electronic Equipment

The Contractor is responsible for all steps, work and activities in the procedure below except when Department responsibility is expressly indicated. At all times, the Contractor is responsible for all equipment and materials, including while being programmed by the Department, and including operation, warranties, and technical support.

Coordinate all aspects of the procedure through the Engineer.

Perform all network equipment programming for a complete project at one time. The Contractor may request in writing for a staged equipment programming; provide a plan with schedule for the complete project that details all of the proposed stages and identifies all network equipment and field sites for each stage. If approved by the Department, the

procedure below applies independently and fully to each individual stage. Field sites will always be programmed concurrently for all of the equipment at that site.

Materials submittal reviews for all network equipment, and related equipment, shall be successfully completed prior to beginning the Network Equipment Programming Procedure.

Step 1

Request in writing for GDOT to prepare and provide the basic equipment programming data. The request shall clearly identify the project. If the Contractor desires a staged equipment programming, that request must be identified at this time and the staging plan must be submitted.

Step 2

Once the Contractor's request is complete, the Department will provide the basic equipment programming data within 45 days from the Department's acceptance of the Contractor's request. Basic equipment programming data will include the IP address, subnet, and gateway for each network device. The programming data will be provided in spreadsheet form.

Step 3

Complete installation of all field equipment, including but not limited to support poles, equipment cabinets, power service, field and network devices, and fiber communications infrastructure. Complete all basic equipment programming. Furnish Network Switch GBICs to GDOT. Furnish all fiber patch cords in the hub(s) but make no connections to the Network Switch. Provide in spreadsheet form the equipment model numbers, serial numbers, MAC addresses, and firmware revision numbers for each network equipment device in its installed location. Complete all field testing required prior to the Interim Field Subnet (IFS) test, and conduct an IFS test dry-run.

Step 4

Request in writing to begin the IFS test a minimum of 30 days in advance of the desired start date. Conduct IFS test in the presence of the Engineer. If the IFS test fails, identify the defects and make corrections, provide a written report on the diagnosis and corrections made, and request in writing an IFS retest a minimum of 14 days in advance of the desired start date.

Step 5

Upon successful and accepted completion of IFS testing, the Department will have 45 days to complete all network and system programming and NaviGator integration of the field devices and hub equipment. Continue with all remaining field construction that has no impact on any equipment or communications infrastructure associated with the network programming. Any disruption of the equipment or communications infrastructure shall result in stopping the 45 day period for Department programming.

Step 6

The Department will notify the Contractor when network programming is successfully completed, at which time the Network Equipment Programming Procedure will be considered completed. Continue with all remaining project activities, including remaining acceptance testing..

939.3.04 Fabrication

A. Cabinet Equipment and Components

Install in Types A, B, C, and D cabinet assembly one (1) fluorescent lighting fixture mounted inside the top front portion of the cabinet. Include with the fixture a cool white lamp, covered and operated by a normal power factor UL listed ballast. Install an RC network noise suppression filter in the light circuit. Install door actuated switches installed to turn on the cabinet light when either door is opened.

Install in Type F cabinet assembly four (4) fluorescent lighting fixtures mounted inside the top portions of the each cabinet side. Include with the fixture a cool white lamp, covered and operated by a normal power factor UL listed ballast. Install an RC network noise suppression filter in the light circuit. Install door actuated switches, front and rear of each door, installed to turn on all cabinet lights when any door is opened.

B. Cabinet Wiring, Conductors, and Terminal Blocks

Use two conductors per DIN terminal block (one conductor per terminal. Wire shall be stripped no longer than is necessary to provide a solid connection to the terminal block. No un-insulated wire shall be exposed at the terminal block. Number all terminal blocks, terminal strips, circuit breakers and have each item and each terminal position numbered and named according to function as shown in the "quoted labels" in the Detail Drawings. Label terminal blocks, terminal strips, and circuit breakers with silk-screened lettering on the mounting panel.

939.3.05 Construction

A. Equipment

1. Installation

- a. Install all equipment in new and/or existing equipment racks and equipment frames in accordance with the equipment manufacturer's recommendations, including mounting, interconnection wiring, and electrical service. Furnish and install all mounting hardware and incidental materials, including fasteners and auxiliary supporting frames/brackets, as recommended by the manufacturer. Furnish and install all miscellaneous hardware, materials, wiring/cabling, configuration, and any other incidental items necessary for fully operational components and subsystems shown in the Contract Documents and Section 940 of the Special Provisions, except when specifically identified as existing or as work to be performed by the Department.
- b. Work in this project may require access to various Department buildings and Hubs requiring coordination of all work activities in these locations with the Engineer before access is needed. Work in this project requires system configuration tasks to be performed by the Department before some Contractor-installed items can be brought online and completely system tested. Coordinate all work activities needing system configuration with the Engineer a minimum of 14 days prior to any testing.
- c. Install all Hub and control center equipment in the presence of the Engineer. Locate new equipment in new or existing equipment racks or equipment frames as shown in the Plans.
- d. Provide proper electrical service, including grounding and current rating, in the equipment racks and equipment frames for all hardware installed under this project. This requirement includes existing and new equipment racks and equipment frames. Obtain Engineer approval prior to installation of all electrical service for hardware in control centers. Furnish and install additional power outlet strips in new and existing equipment racks and equipment frames if needed for the new equipment.
- e. For any equipment that is not rack mountable with "rack ears", provide perforated shelves and secure all shelf-mounted equipment with rack mounting hardware.
- f. Label all wiring and cabling, including building entrance cables, jumper and patch cords, and power supply cables, using cable identification numbers as shown in the Plans or provided by the Engineer. Apply cable labels at each end and in the center of the cable. Cable labels shall consist of permanent ink printed or legibly written on self-laminating and over-wrapping label material.
- g. Protect cable ends at all times with acceptable end caps. Never subject any coaxial cable to a bend radius of less than six (6) inches. Provide grommets, guides and/or strain relief material where necessary to avoid abrasion of or excess tension on wire and cable.

2. Serial Data Terminal Server

For Hubs, install the Serial Data Terminal Servers, 16 Port, in equipment frames as shown in the Plans and in accordance with the Manufacturer's recommendations. For equipment cabinets and as required, install the Serial Data Terminal Servers, Type B, as shown in the Plans and in accordance with the Manufacturer's recommendations. Furnish and install all interconnection wiring and power service connections.

3. Patch Cords

a. General Requirements:

- 1) Use patch cords only within control center buildings, communication Hubs, and equipment cabinets.
- 2) Label all patch cords using cable identification numbers as shown in the Plans or provided by the Engineer. Apply cable labels at each end and in the center of the cable. Use printer-generated adhesive overlapping cable labels.

- 3) Neatly route, dress and secure patch cords in the equipment racks or frames and at both ends. Use all available cable management devices and/or trays. Route patch cords only vertically on the sides of the equipment racks and frames or horizontally across the bottom or top of the racks and frames; no diagonal routing is permitted. Follow all manufacturer's recommendations including bend radius requirements during all patch cord installation.

- b. Fiber Optic Patch Cords: Furnish and install fiber optic patch cords in accordance with Section 935 and this section.
- c. Coaxial Video Patch Cords: Where an equipment or termination facility has a connector other than BNC (such as an RCA), furnish and install a BNC adapter to connect the patch cord to the equipment or termination facility.
- d. Data Patch Cords: Use data patch cords to connect all local area network and RS-standard (e.g., RS-232, RS-422/485) serial data termination facilities and equipment.
 - 1) Where an equipment or termination facility has a connector other than an RJ45 outlet (such as a "D-shell" connector), furnish and install RJ45 adapters between the connectors and the network/data patch cords as approved by the Department. For any type of RJ45 adapter, provide the proper pin-out of the adapter as part of the documentation.
- e. Network Switch / Field Switch Patch Cables: Furnish and install Category-6 unshielded twisted pair (UTP)/shielded twisted pair (STP) patch cables that comply with EIA/TIA-568-A standards for all network to device interconnects (device to switch).
- f. Voice/Telephone Patch Cords: Use voice/telephone patch cords to connect all voice or telephone communications facilities and equipment. Furnish and install the voice/telephone patch cords with the necessary pair sizing and connector for the equipment being connected.

4. Network Switch, Layer 3 Gig-E

For Hubs, furnish and install Network Switches, Layer 3 GigE that are compatible with the existing NaviGator Ethernet network as shown in the Plans, as applicable. The existing network consists of Nortel Networks 8600 Layer 3 GigE switches.

Furnish and install the network switch and all fiber optic jumper cabling necessary to connect to the fiber optic cable FDC as shown in the Plans.

5. Hub Uninterruptible Power Supply

Furnish and install a dedicated electrical service branch circuit from the Hub main service panel for the UPS system. Ensure that the UPS system branch circuit is in accordance with all recommendation of the UPS manufacturer, including the provision of a locking plug/receptacle connection. Make all electrical conduit and fittings rigid EMT or approved equivalent. Locate the branch circuit receptacle as close as possible to the UPS mounting position to minimize the UPS input line cord and to minimize tripping hazards.

Configure the electrical service inputs for all network switches, serial data terminal servers, video encoders/decoders, and video switches to be supplied by the UPS. Furnish and install line cords, power strips, and all incidental materials to configure the UPS service to the above equipment.

B. Communications Subsystem

1. General

- a. Use Network Switches, Layer 3 Gig-E, Field Switches, Serial Data Terminal Servers, and Video Encoders/Decoders, as necessary or required to establish:
 - 1) For Traffic Signals, digital data communications between local controllers and system masters and to and from Hubs and control centers
 - 2) For Ramp Meters, digital data communications to and from equipment cabinets/Hubs/control centers
 - 3) Digital camera video and control data communications to and from equipment cabinets/Hubs/control centers
 - 4) Digital CMS control data communications to and from equipment cabinets/Hubs/control centers
 - 5) Digital detector data communications to and from equipment cabinets/Hubs/control centers

- 6) Digital VDS processor control data communications to and from equipment cabinets/Hubs/control centers
- b. Furnish and install Network Switches, Layer 3 Gig-E, Field Switches, Serial Data Terminal Servers, and Video Encoders/Decoders, as necessary or required as specified in the Plans to ensure proper communications.

2. Installation Requirements

Install all communications equipment and materials necessary for a complete communications path from the field site to the control center or communications Hub as shown in the Plans. Furnish and install all mounting and interconnection materials, including but not limited to card cages, mounting panels and rack hardware, fiber, patch/jumper cables, and power supply cables. Mount card cages and mounting panels as shown in the Plans and Detail Drawings in this section. Furnish and install the type and quantity of equipment shown in the Plans. Where the Plans show that new Field Switches, Video Encoders, VDS System Processors, Modems, and/or other devices are to be placed in existing cabinet space, furnish and install compatible mounting hardware, as required.

Label all wiring and cabling, including entrance cables, jumper and patch cords, and power supply cables. Cable labels shall consist of permanent ink printed or legibly written on self-laminating and over-wrapping label material.

- a. Equipment Cabinet Mounting: All field equipment shall be mounted in a manner as to not restrict the replacement of other components in the cabinet housing.
- b. Hub/Control Center Mounting: Where data is transmitted to a receiving end such as a Hub, TCC or TMC, permanently mount the equipment as required within an equipment rack, frame.

3. Radar Dial-up Modem

Furnish and install all cabling required to connect the radar dial-up modems to the telephone lines and the radar workstation.

4. CMS Dial-up Modem

Furnish and install all cabling required to connect the CMS dial-up modems to the telephone lines and the CMS workstation.

C. Equipment Cabinet Assembly

1. General Requirements

Furnish and install the equipment cabinet assembly to include all devices/components, assembly, wiring and materials required in this Subsection 939.3.05.C and in Subsection 939.2.B.

The equipment cabinet assembly, as described below, shall conform to all applicable sections of the Caltrans specifications and Georgia DOT Standard Specifications.

2. Classification of Types

Furnish and install equipment cabinet assemblies as called for in the Plans in accordance with the following requirements for each type.

- a. Type A Cabinet – Not Applicable.
- b. Type B Cabinet – Not Applicable.
- c. Type C Cabinet: Furnish and install a Type C Cabinet that conforms with all materials and installation requirements of this Subsection 939.3.05.C and Subsection 939.2.B using a Type C Standard Cabinet Housing (see Detail Drawing in this section).
- d. Type D Cabinet: Furnish and install a Type D cabinet assembly that conforms with all materials and installation requirements of this Subsection 939.3.05.C and Subsection 939.2.B using a Type D Standard Cabinet Housing (see Detail Drawing in this section).
- e. Type F Cabinet: Furnish and install a Type F cabinet assembly that conforms with all materials and installation requirements of this Subsection 939.3.05.C and Subsection 939.2.B using a Type F Standard Cabinet Housing (see Detail Drawing in this section).

3. Identification and Documentation

Include the manufacturer's name only on the inside of the front cabinet door along with the cabinet model number, serial number, schematic wiring diagram number, and month/year of manufacture. Provide this information on a waterproof, permanently affixed label.

Identify all components of the cabinet assembly, which are mounted on panels. Make identification on the panels with permanent silk-screen or other printed labels. These components include but are not limited to terminal blocks (with all positions numbered and labeled), panel and socket mounted surge suppressors, circuit breakers, accessory and equipment outlets, and communications transmitters/transceivers.

Provide complete documentation with each cabinet. Identify all cabinet documentation, including the maintenance logbook, by field site name and system ID. Make all cabinet documentation (except that documentation contained in the maintenance logbook below) on ledger size non-fading xerographic black-on-white 20# or greater bond paper. Supply four (4) sets of schematic wiring diagrams with complete parts lists with each cabinet. Draft the diagrams in neat, workmanlike manner. The diagrams shall be completely legible at the specified paper sizes and be non-proprietary. Identify in the diagrams all circuits in a manner as to be readily interpreted. Include in the diagrams a cabinet drawing showing the equipment layout in a front and rear elevation view and front views of each of the side panels. Label all equipment on the drawings with the same identifiers as labeled on the panels themselves. Identify all cabinet electrical components and equipment and the ventilation filter on parts lists on the wiring diagrams or in the maintenance logbook. The parts lists shall include manufacturer and complete model number. Store the diagrams in the documentation pouch on the door.

Include in the cabinet documentation an equipment list and maintenance logbook. This maintenance logbook shall contain a list of all major removable equipment items in the cabinet and all major items installed outside of the cabinet including but not limited to Field Switch, Video Encoders, VDS System Processors, Modems, CCR, camera, lens, housing, and pan/tilt unit, along with manufacturer name, model, and serial numbers. Include in the equipment list in the logbook spaces to enter the communications address, system identifier, and other site-specific configuration information. The maintenance logbook shall include a minimum of five (5) blank forms for documenting site visits, including the date, time, technician name, and work performed. The maintenance logbook pages shall be standard letter size 3-hole 20# or greater white paper bound in a plastic report cover.

4. Internal Cabinet Assembly Components and Wiring

a. Cabinet Assembly Installation

- 1) Install the cabinet assembly as shown in the Plans. Provide the cabinet assembly with a grounding system in accordance with the Department's Standard Specification for Traffic Signal Equipment grounding. Measure the resistance to ground in the presence of the Engineer. Resistance to the ground cannot exceed ten (10) ohms. Do not splice the ground conductor between the cabinet grounding terminal and the ground rod. Isolate and insulate the ground conductor from any utility grounding equipment. Completely isolate the cabinet assembly grounding system from any other grounding system, including the support pole grounding system, such that there is no electrical bond between any equipment (cabinet, conduit, camera support bracket, etc.) and any other grounding system. In the case of steel support poles, it is not necessary to insulate equipment strapped to the pole.
- 2) Mount all pole mounted cabinet assemblies to the support pole at a height of 4 ft +/- 3 in (1.2 m +/- 76 mm) from ground level to the centerline of the cabinet housing. Where the Plans show base-mounted cabinets, install the cabinets in accordance with the Department's Standard Specification for Traffic Signal Equipment installations.
- 3) Enclose all cabling and wiring entering the cabinet housing in conduit. Securely and neatly dress all cabling and wiring inside the cabinet, including field wiring. Provide sufficient slack (minimum 2 ft. (600 mm)) for cabinet equipment maintenance and re-termination of the field wiring. Route fiber drop cables into the cabinet to provide as much physical protection as possible. Secure the drop cables through the cabinet, and strain-relieve them within the fiber termination unit.

b. Wiring, Conductors and Terminal Blocks:

- 1) Use stranded copper for all conductors, including those in jacketed cables, except for earth ground conductors, which may be solid copper. Neatly arrange all wiring, firmly lace or bundle it, and mechanically secure the wiring without the use of adhesive fasteners.
- 2) Route and secure all wiring and cabling to avoid sharp edges and to avoid conflicts with other equipment or cabling. Route camera control wiring, and 120VAC power wiring separately. Terminate all wiring on the DIN rail terminals. Use a minimum #12 AWG THHN-THWN for all conductors of 120VAC circuits. Install all wiring as shown in the Detail Drawings.

c. Surge Suppression:

- 1) Protect all copper wiring and cabling entering the cabinet housing, except for the earth ground conductor, by surge suppression devices as specified.
- 2) Terminate all power supply wiring between cabinet devices and the transient surge suppressors on DIN terminal block. Use a minimum #12 AWG grounding of each surge suppression device, or larger if recommended by the surge suppression device manufacturer. Use insulated green wire and connect the ground wire directly to the ground terminal block.
- 3) Do not "daisy chain" with the grounding wires of other devices including other surge suppressors. Dress and route grounding wires separately from all other cabinet wiring. Install grounding wires with the absolute minimum length possible between the suppressor and the ground terminal block. Label all surge suppressors with silk-screened lettering on the mounting panel.

d. Component Installation:

- 1) All components/devices of the cabinet assembly are to be rack mounted with Phillips-head machine screws. Install screws into tapped and threaded holes in the panels. These components/devices include but are not limited to DIN rails, terminal blocks, accessory and equipment outlets, DC power supply chassis, video encoders, video processors, and field switches.
- 2) Fasten all other cabinet components with hex-head or phillips-head machine screws installed with nuts (with locking washer or insert) or into tapped and threaded holes. These other components include but are not limited to door switches, fans, lights, thermostats, , and door lock mechanisms. Fasten stud-mounted components to a mounting bracket providing complete access to the studs and mounting nuts. All fastener heads and nuts (when used) shall be fully accessible with a complete cabinet assembly, and any component/device shall be removable without requiring removal of other components, panels, or mounting rails. Do not use self-tapping or self-threading fasteners.

5. Cables, Conduit and Power Service

Furnish and install electrical cables, conduit and power service necessary to make the system fully operational.

a. Electrical Cables:

- 1) Furnish and install electrical cables for providing electrical power service to the site and for providing telephone and/or /DSL service and/or cable service from the telephone company demarcation point to the equipment cabinet.
- 2) Furnish and install electrical cables used for power service, including grounding, in accordance with the Standard Specifications for electrical, lighting and traffic signal equipment.
- 3) Furnish and install electrical cables used for power supply as shown in the Detail Drawings. Do not splice any cable; shield or conductor used for power supply. Identify all conductors of all cables by color and number. Identify the conductor function in as-built documentation included in the cabinet documentation.
- 4) Electrical cables installed for telephone service from the telephone company demarcation point to the equipment cabinet shall be minimum #22 AWG twisted pair, UV-resistant shielded cable rated for wet/dry direct burial use. Install telephone service cable directly to or into the equipment cabinet in accordance with telephone company procedures. Install telephone service cable from the telephone company demarcation point to the equipment cabinet. Unless otherwise shown in the Plans or directed by the Engineer, install the telephone cable underground in conduit of minimum 1 in. (25 mm) diameter. Make all necessary connections at the telephone interface box and inside the equipment cabinet for proper operation of the video, control signaling and communications signaling. Neatly coil a minimum of 2 ft. (0.6 m) of telephone service cable in the bottom of the cabinet.

b. Electrical Conduit:

- 1) Install electrical conduit to provide enclosures for electrical cables at or terminating at the site. Furnish and install electrical conduit in accordance with the Standard Specifications for electrical, lighting and traffic signal equipment, and as required below.
- 2) Make all aboveground electrical conduit and conduit bodies rigid metal except as noted below. Terminate all aboveground conduit in either a weather head or in a cabinet. All conduits entering a pole-mounted equipment cabinet shall enter through the bottom with at least one conduit body with a sealable, removable cover for pulling access. All conduits entering in a base-mounted cabinet shall enter through the foundation and the base-mount adapter.

- 3) Install electrical conduits for electrical power service drops to the cabinet in the diameter indicated in the Plans. Conduits used as risers from a cabinet shall be minimum 2 in. (50 mm) diameter. Make nipples, welded collars, conduit bodies (e.g., LB condulets) and weather heads in hollow metal or concrete poles at the device mounting locations and at the cabinet mounting locations a minimum 2.5 in. (63 mm) diameter.

c. Electrical Power Service:

- 1) Furnish and install materials and equipment to bring electrical power service to the cabinet from the source shown in the Plans. Furnish and install electrical power service in accordance with the Standard Specifications for electrical, lighting and traffic signal equipment, and as required below.
- 2) Provide and terminate electrical power service equipment at the power service source as shown in the Plans. If the power service source is shown as a new power service drop, then furnish and install an electrical power service assembly at the new service drop location in accordance with the Standard Specifications. Include, as a minimum, with the electrical power service equipment at a new drop a service disconnect, surge arrestor, grounding electrode and conductor, and all necessary conduit, wiring and hardware. Provide a ground conductor, other than the electrical service conduit, between the electrical service disconnect ground buss and the equipment cabinet service entrance terminal block SE. Furnish and install a service metering base where required by the local utility or electrical codes or where shown in the Plans. Include a minimum 30 ampere circuit breaker with electrical service disconnects. Mount the electrical surge arrestor on the disconnect housing. The arrestor shall be rated for a maximum permissible line to ground voltage of 175RMS, and shall be in conformance with NEMA standards for surge arrestors. Electrical service conduit shall be minimum 2 in. (25 mm) diameter. Separate electrical service conduit from all other conduit. This conduit cannot contain any other wiring. Dedicate electrical service conduit from the electric utility drop point through the meter base and disconnect and to the cabinet, where the electrical service conduit shall enter the cabinet through the cabinet bottom.
- 3) If the power service source is an existing service drop, then furnish and install the necessary materials and equipment to supply service to the cabinet from the existing service drop. Unless otherwise shown in the Plans, service the cabinet from a dedicated branch circuit with circuit breaker. Make all electrical service installation from the existing drop point as specified for new power service drops above.
- 4) Furnish and install surge suppression at all electrical power service sources. Ground all electrical power service sources and bond the AC neutral and ground at the power service source only.
- 5) The contractor will establish accounts with the appropriate utility provider. After all accounts are established, the contractor will submit the utility transfer form to the appropriate DOT Utility office through the Engineer for transfer. The Engineer will provide the utility transfer form to the contractor.

939.3.06 Quality Acceptance

The Engineer, based on justification of public interest, may order any completed or partially completed portions of the project placed in service. Such action is not an acceptance of the project in whole or in part, nor is it a waiver by the Engineer of any provision of the specifications. Assume no right to additional compensation or extension of time for completion of the work or any other concession because of the use of the project or any part thereof prior to final acceptance of the completed project. Fully maintain all equipment prior to final acceptance, which includes but is not limited to equipment configuration and communication systems.

Perform all acceptance testing in the presence of the Engineer. Notify the Engineer of a desired acceptance test schedule no less than fourteen calendar days prior to beginning the testing except for testing using the NaviGator software and existing NaviGator control center and communications equipment. For acceptance testing using the NaviGator software and existing NaviGator control center and communications equipment, coordinate the testing schedule with the Engineer no less than 30 days prior to the start of this testing. Do not conduct any testing during any State or Federal holiday.

A. Equipment

1. General

Coordinate all work activities needing system configuration with the Engineer a minimum of 14 days prior to any testing.

Work in this project includes furnishing specific equipment to the Department for configuration and use by the Department during the course of the project. Operate this equipment and maintain the proper configuration until

final acceptance of the project, including throughout the project duration after the Department has started using the equipment.

2. Start-up Testing

Provide start-up testing for the various devices supplied as described herein and as further detailed in the respective equipment specification section.

The Contractor shall provide a test plan and procedures for review and approval by the Engineer prior to any testing. The Contractor shall conduct a pre-test prior to contacting the Engineer prior to final inspection. Pretest shall be defined as all tests that are performed for the Engineer during inspection. The Contractor shall provide all test equipment and software necessary to perform the tests. Perform all tests in the presence of the Engineer unless otherwise specified.

Include in the test plan and procedures, as a minimum, the following tests:

- Device or system power-on self test
- Conduct visual inspection of device or system to confirm presence of all components and features specified by the Contract specifications and otherwise customarily provided by the manufacturer
- Test using the built-in manufacturer's product or system diagnostics to confirm proper performance
- Test all input and output ports
- Demonstrate that all functional features of the device or system are operational
- An operational test demonstrating equipment performs as intended and as prescribed by the manufacturer and meets the requirements of the Contract specifications.

Configure the components of the device, make necessary settings or adjustments, and power-on according to the manufacturer's instructions.

3. Serial Data Terminal Server

Prior to acceptance of any Serial Data Terminal Servers (all Types), the following shall be performed:

- Connect with serial cable to Serial Data Terminal Server with PC or laptop using HyperTerminal.
- Ensure that the Serial Data Terminal Server recognizes all ports and attached expansion modules.
- Input addressing for Serial Data Terminal Server and reset.
- Determine successful Ethernet connectivity (link light at Hub/switch).
- Successfully telnet from PC or laptop to Serial Data Terminal Server through Hub/switch.
- Print to screen configuration information that is consistent with addressing data previously entered into Serial Data Terminal Server.

4. Field Switches

Prior to acceptance of any Field Switch (all Types), the following shall be performed:

a. Stand-alone Acceptance Test (SAT)

- 1) The Contractor shall provide the test plan and procedures for review and approval by the Department prior to any SAT activities. The test procedures shall provide comprehensive tests to verify and demonstrate full compliance with these specifications and device functionality. Pass and fail criteria shall be identified for each tests for review and approval by the Department.
- 2) The Contractor shall provide all test equipment and software necessary to perform the tests.
- 3) The Department will perform the SAT in a test area provided by the Department. A Contractor representative shall be present during the SAT.
- 4) The Field Switch will be assembled and connected to power in a stand-alone configuration.
- 5) The Field Switch will be powered up and allowed to initialize, boot and run self-diagnostic tests as defined in the Department-approved test procedures.
- 6) After the Field Switch has started and initialized, test procedures will be executed.

- 7) After the test procedures have been executed, the Field Switch will be allowed to run, uninterrupted, for a burn-in period of seventy-two (72) hours.
- 8) At the end of the burn-in period, the unit will be re-started and configuration verified.

Upon completion of all test procedures, the Contractor will be notified of SAT Field Switch acceptance or failure. If the unit fails the test, the Contractor shall replace it at no additional cost to the Department and the test procedure shall be re-started.

b. Operational Test

- 1) The Contractor shall provide the test plan and procedures for review and approval by the Department prior to any Operational Test activities. The test procedures shall provide comprehensive tests to verify and demonstrate full compliance with these specifications in regards to device or subsystem network performance. Pass and fail criteria shall be identified for each tests for review and approval by the Department.
- 2) The Contractor shall provide all test equipment and software necessary to perform the tests.
- 3) After successful completion of the SAT, the Department will configure and connect the Field Switch to the GDOT Network.
- 4) Verify communications and network control from the Field Switch to/from the Hub and TMC.
- 5) Verify system integrity through comprehensive diagnostics.
- 6) Verify 10/100Base-T/TX interfaces and operations.
- 7) Verify 1000Base-X interfaces and operations.

Upon completion of all the tests, the Contractor will be notified of Operational Field Switch acceptance or failure. If the unit fails the test, the Contractor shall replace the unit at no additional cost to the Department and the test procedure shall be restarted.

5. Video Encoders & Decoders (All Types)

Prior to acceptance of any Video Encoder and Decoder, (All types), the following shall be performed:

a. Stand-alone Acceptance Test (SAT)

- 1) The Contractor shall provide the test plan and procedures for review and approval by the Department prior to any SAT activities. The test procedures shall provide comprehensive tests to verify and demonstrate full compliance with these specifications and device functionality. Pass and fail criteria shall be identified for each tests for review and approval by the Department.
- 2) The Contractor shall provide all test equipment and software necessary to perform the tests.
- 3) Using the Department approved Contractor-supplied test plan and procedures, the Department will perform SAT in a test area provided by the Department. A Contractor representative shall be present during the SAT.
- 4) The Video Encoder/Decoder will be assembled and connected to power in a stand-alone configuration.
- 5) The Video Encoder/Decoder will be powered up and allowed to initialize, boot and run self-diagnostic tests as defined in the Department-approved test procedures.
- 6) After the Video Encoder/Decoder has started and initialized, the test procedures will be executed.
- 7) After the test procedures have been executed, the Video Encoder/Decoder will be allowed to run, uninterrupted, for a burn-in period of seventy-two (72) hours.
- 8) At the end of the burn-in period, the unit will be restarted and configuration verified.

Upon completion of all test procedures, the Contractor will be notified of SAT acceptance or failure. If the unit fails the test, the Contractor shall replace the unit and/or update the firmware as required at no additional cost to the Department and the test procedure shall be restarted.

b. Operational Test

- 1) The Contractor shall provide the test plan and procedures for review and approval by the Department prior to any Operational Test activities. The test procedures shall provide comprehensive tests to verify and demonstrate full compliance with these specifications in regards to device or subsystem network performance. Pass and fail criteria shall be identified for each tests for review and approval by the Department.
- 2) After successful completion of the SAT, the Contractor shall configure and connect the Video Encoder to the field switch and GDOT network.
- 3) Along with the Video Encoder, the Contractor shall provide a Video Decoder unit (as specified herein), a video monitor, a laptop, and camera control application provided by the Department. The Contractor shall be responsible to provide all test equipment and software necessary to perform the tests.
- 4) Verify MPEG video performance over the GDOT network.
- 5) Verify serial data channel performance using NaviGator PTZ control commands.
- 6) Verify and demonstrate user programmable parameters and functions.
- 7) Verify and demonstrate network management and remote configuration.

Upon completion of all the tests, the Contractor will be notified of Operational Test acceptance or failure. If the unit fails the test, the Contractor shall replace the unit and/or update the firmware as required at no additional cost to the Department and the test procedures shall be re-started.

6. Interim Field Subnet Test

Prior to acceptance of any network communications equipment or field device connected to the communications network, perform and successfully complete an Interim Field Subnet (IFS) test. All Start-Up and Standalone testing shall be successfully completed on all devices before an IFS test can begin. Include in the IFS test all network communications devices in the project, including but not limited to all field switches, video encoders and decoders, VDS processors, CMS controllers, microwave radar detectors, serial data terminal servers, ramp meter signal controllers, and traffic signal controllers.

- a. Provide the test plan and procedures for review and approval by the Department prior to any IFS activities. The test procedures shall provide comprehensive tests to verify and demonstrate full compliance with these specifications and device functionality. Pass and fail criteria shall be identified for each test for review and approval by the Department. The test procedures shall identify all field sites and devices in the project, as well as the field subnets the sites are attached to.
- b. Furnish all test equipment and software necessary to perform the tests, including but not limited to laptop PC with web browser and network analysis software, temporary field switch or other compatible media converter, and all necessary patch cords.
- c. Prior to conducting a scheduled IFS test, conduct a dry-run test to ensure all preparations for the IFS test are complete. The Engineer reserves the right to attend the dry-run test.
- d. An IFS test shall be conducted for each field subnet, which is typically a group of field sites connected to a fiber pair ring between two hubs. The test shall be conducted from one of the hubs. During the test, every network device shall be pinged, probed by SNMP or equivalent status queries, logged into, and connected to by other methods as needed to demonstrate that the equipment is functional, contains the proper base programming data, and is in the proper location.

939.3.07 Contractor Warranty and Maintenance

Provide a Manufacturer's support (usual and customary warranties) period for all equipment and materials furnished and installed as part of the Communications and Electronic Equipment System. Include in warranty and support all Contractor or Manufacturer activities related to maintenance, removal and replacement of parts and materials during the period of support. Begin the Manufacturer warranty support period upon successful completion of equipment cabling and component testing as outlined in Subsection 939.3.06. All Manufacturer warranties shall be continuous throughout the period and state that they are subject to transfer to the Department.

939.3.08 Training

Provide training as required herein. Include with training all supplies, equipment, materials, handouts, travel, and subsistence necessary to conduct the training. Furnish a training notebook in a labeled 3-ring binder to each trainee. Include in the cost of training all supplies, equipment, materials, handouts, travel, and subsistence necessary to conduct the training.

Provide installation, operations, and maintenance training on the equipment at a site near the project area. Personnel trained by the various equipment manufacturers and authorized by said manufacturers shall perform the training. Provide installation, operations and maintenance training for up to twelve (12) people. Include in this training both classroom training and hands-on training. Limit in-shop and in-field training to group sizes of four (4) people at a time. Conduct all training in half-day sessions. Two half-day sessions may be held on the same day. The total of the training shall consist of at least six (6) clock hours of training for each participant. Provide a course content of, at a minimum, the following:

Field Switches

- Unit set-up and configuration
- Diagnostic and maintenance
- Performance tuning
- Hands-on use of Field Switches for each trainee

Video Encoders and Decoders

- Installation of all digital video compression system equipment
- Explanation of MPEG-4 digitized video
- Maintenance of all digital video encoder and decoder system components including software
- Measurement of digital video signals
- Hands-on use of digital video transport system equipment for each trainee

If CCTV training is also required in the project, digital video transport system training shall be provided in conjunction with the CCTV training specified herein. If so, the total of the CCTV and digital video transport system training shall consist of at least eight (8) clock hours of training for each participant. Meet all CCTV training requirements of Subsection 936.3.08.

939.4 Measurement

B. Equipment

For each equipment unit listed below, furnish and install all mounting and interconnection materials, including but not limited to card cages, mounting hardware, all patch cords of all types, and power strips and power supply cables at no separate cost to the Department. If software device drivers/communication protocols not currently incorporated into NaviGator software are needed, provide and integrate them at no separate cost to the Department.

1. Serial Data Terminal Server:

Serial Data Terminal Servers (16 Port and all Types) are measured for payment by the number actually installed, complete, functional and accepted. For each unit provided, furnish and install any required Serial Data Terminal Servers and serial port concentrators as specified in Subsection 939.2.A.2 and in the Plans at no separate cost to the Department.

2. Hub Uninterruptible Power Supply:

Hub Uninterruptible Power Supplies are measured for payment by the number actually installed, complete, functional and accepted.

3. Network Switch, Layer 3 Gig-E:

Network Switches, Layer 3 GigE (all Types) are measured for payment by the number actually installed, complete, functional and accepted. For each unit provided, furnish and install any required switching Hubs, router and switching chassis as specified in Subsection 939.2.A.5 and in the Plans at no separate cost to the Department.

4. GBIC Routing Switch Module:

GBIC Routing Switching Modules (all Types) are measured for payment by the number actually installed, complete, functional and accepted

5. GBICs:

GBICs (all Types) are measured for payment by the number actually installed, complete, functional and accepted.

6. Field Switches:

Field Switches (all Types) with rack mounting hardware are measured for payment by the number actually installed, complete, functional and accepted.

7. Video Encoders, Type B:

Video Encoders, Type B, with rack mounting hardware are measured for payment by the number actually installed, complete, functional and accepted.

8. Video Encoders, Type C:

Video Encoders, Type C, with rack mounting hardware are measured for payment by the number actually installed, complete, functional and accepted.

9. Video Decoders, Type B:

Video Decoders, Type B, with rack mounting hardware are measured for payment by the number actually installed, complete, functional and accepted.

10. Video Decoders, Type C:

Video Decoders, Type C, with rack mounting hardware are measured for payment by the number actually installed, complete, functional and accepted.

11. Equipment Frame:

Equipment frames are measured for payment by the number actually installed, complete, functional and accepted.

12. Dial-Up Modems:

As required, dial-up modems are measured for payment by the number actually installed, complete, functional and accepted. For each unit installed, furnish and install all mounting and interconnection materials, including but not limited to card cages, shelves, hardware, fiber, jumper cables, RS-232/422/485 converters and power supply cables at no separate cost to the Department.

C. Equipment Cabinet Assembly

Equipment cabinet assemblies are measured for payment by the number actually installed, complete, functional and accepted. For each unit installed, furnish all required items, including but not limited to identification and documentation, lighting, contact switch, fan, contact-closure sensor, patch cords, and cables at no separate cost to the Department.

D. Electrical Power Service Assembly

Electrical power service assemblies are measured for payment by the number actually installed, complete, functional, and accepted. For each assembly installed, furnish all required items, including but not limited to conduit; riser; wiring; hardware; disconnect; meter base; and Class 3, 30 ft. (9 m) timber pole at no separate cost to the Department. Exceptions to the previous sentence include horizontal conduit, wiring, Type 2 pull boxes, electrical junction boxes, and directional bores between the electrical service pole to the equipment cabinet requiring power service which will be measured for payment as conduit, nonmetal, type 2 – power service as per Section 682.

E. Testing

Testing is measured as a lump sum for full delivery of testing and acceptance requirements.

F. Training

Training is measured as a lump sum for all supplies, equipment, materials, handouts, travel, and subsistence necessary to conduct the training.

939.4.02 Limits - Not applicable

939.5 Payment

Payment is full compensation for furnishing and installing the items complete in place according to this Specification.
Payment for all items is as follows:

Item No. 939	Serial Data Terminal Server, 16 Port and Type _	Per Each
Item No. 939	Type _ Cabinet	Per Each
Item No. 939	Electrical Power Service Assembly (type)	Per Each
Item No. 939	Network Switch, Layer 3 Gig-E, Type _	Per Each
Item No. 939	GBIC Routing Switch Module, Type _	Per Each
Item No. 939	GBIC, Type _	Per Each
Item No. 939	Field Switch, Type _	Per Each
Item No. 939	Video Encoder, Type _	Per Each
Item No. 939	Video Decoder, Type _	Per Each
Item No. 939	Hub Uninterruptible Power Supply	Per Each
Item No. 939	Equipment Frame	Per Each
Item No. 939	Testing	Lump Sum
Item No. 939	Training	Lump Sum

939.5.01 Adjustments

Not applicable

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA**

SPECIAL PROVISION

**P.I. No.: 0010290 & 0010311
Fulton County
Forsyth County**

**SECTION 940 – NAVIGATOR ADVANCED TRANSPORTATION
MANAGEMENT SYSTEM INTEGRATION**

**Section 940 - NaviGator Advanced Transportation Management
System Integration**

Add the following:

940.1 General Description

This work includes coordination and integration of the project into the Department's NaviGator advanced transportation management system to provide a complete and fully operational expansion of the Department's NaviGator system as shown in the Contract Documents.

An example project follows:

Project scope includes installation of communications and field equipment that will provide information to the Transportation Management Center (TMC) and other facilities. The backbone of the communication system is a fiber optic cable infrastructure utilizing IP protocols over Ethernet technology. Ethernet switching equipment is used to transport the data from field devices to hub buildings. Routing equipment at the hub-building routes the data to the TMC and other facilities as needed. Cameras will provide video for traffic surveillance and vehicle detection. Changeable message signs and surveillance cameras will be controlled from the TMC. Ramp Metering Operation will communicate with the NaviGator System using center-to-center communication between NaviGator and ACTRA. ACTRA will communicate to the Ramp Metering firmware.

Each hub-building and assigned field devices are configured as an IP subnet within the GDOT overall network. Each field device (VDS processor, CMS controller, video encoder and decoder) incorporates its own IP address. Each field device will connect to a field switch at the equipment cabinet. The field switches (located in the equipment cabinets) will be daisy-chained using GBIC optical links to form a string. The ends of the daisy-chained switches are terminated at different hub buildings.

Make communications between the surveillance cameras and the network by means of Ethernet video encoders as shown on the Plans. Make communications from the VDS sites by means of Ethernet compatible video detection system processor(s) at each VDS site. Make communications between the CMS and the network by means of CMS controllers incorporating Ethernet ports. Make communication between the ramp metering operations and the network using an Ethernet field switch within the Ramp Meter Controller Cabinet.

At the hubs buildings, data communication arrives through the field switches using Layer 2 protocols. At the hub building routers will disseminate the data as needed across the backbone network.

Video decoders will be used for decoding of the video images at specific locations as shown on Project Plans.

At Project completion, a complete and useable system comprised of all components involved in the Project will be established.

940.1.01 Related References

A. Georgia Standard Specifications

Section 631 – Permanent Changeable Message Signs

Section 647 – Traffic Signal Installation

Section 797 – Hub Buildings

Section 925 – Traffic Signal Equipment

Section 935 – Fiber Optic System

Section 936 – Closed Circuit Television System (CCTV)

Section 937 – Video Detection System

Section 938 – Microwave Radar Detection

Section 939 – Communication and Electronic Equipment

B. Referenced Documents

Not applicable

940.1.02 Submittals

Submit six copies of the Integration Plan to the Engineer within 15 days of Contract Notice to Proceed. Submit six copies of the Acceptance Test Plan to the Engineer within 45 days of Contract Notice to Proceed.

940.2 Materials

Not applicable

940.3 Construction Requirements

Not applicable

940.3.01 Personnel

Not applicable

940.3.02 Equipment

Not applicable

940.3.03 Preparation

Not applicable

940.3.04 Fabrication

Not applicable

940.3.05 Construction

Not applicable

940.3.06 Quality Acceptance

If, in the Department's judgement, the Contractor is not demonstrating progress in solving any technical problem, the Contractor may be directed to supply Factory technical representation and diagnostic equipment at no cost to the Department until satisfactory resolution of those defined problems.

The Engineer may direct any completed or partially completed portions of the project placed in service. Such action cannot be deemed an acceptance of the project in whole or in part, nor shall such action be construed as a waiver by the Engineer of any provision of the specifications. Assume no right to additional compensation or extension of time for completion of the work. Fully maintain all equipment until final acceptance, which includes but is not limited to equipment configuration and communication systems that are being integrated.

Perform all acceptance testing in the presence of the Engineer. Notify the Engineer of a desired acceptance test no less than fourteen calendar days prior to beginning the testing except for testing using the NaviGator software and existing NaviGator control center and communications equipment. For acceptance testing using the NaviGator software and existing NaviGator control center and communications equipment, coordinate the testing schedule with the Engineer no less than 30 days prior to the start of this testing. Do not conduct any testing during any State or Federal holiday.

Ramp Meter Testing

The Contractor shall submit to and obtain approval from the Engineer a ramp metering testing procedure for each specific ramp meter location. The testing procedure shall demonstrate that all components: hardware, cable, and connections furnished and installed by the contractor operates correctly and that all functions are in conformance with the specifications. Testing requirements are also outlined in Section 647.

The Department will provide controller firmware. The Contractor shall provide the controller to the Department. The Department will load the firmware into the controller and return to the Contractor

At a minimum, the Contractor shall demonstrate to the Engineer:

- The I-VDS and loop detectors at each location are functioning with expected accuracy as specified.
- The ramp meter signals function properly at all stages, including non-metering, startup, metering, and shutdown.
- In multi-lane configurations, the ramp meter can operate a simultaneous release of vehicles from all lanes and as well as an alternating or staggered release of vehicles from the two (or three) lanes..
- Queue detectors are functioning as specified, including both queue detection and queue override.
- The ramp meter functions properly for both local traffic responsive and time of day operations.
- The advance warning sign can be clearly seen and can be activated and deactivated properly.

- The ramp meter can communicate properly with the Hub/TMC.
- The traffic enforcement heads are operating as per the plans and can be seen by enforcement personnel.

The Contractor shall coordinate closely with the NaviGator system integrator for conducting ramp meter operational tests. Note: Pretest should be performed prior to calling the Engineer for inspection. Pretest shall be defined as all tests that will be performed during the Engineer's inspection. Begin operational tests after the Engineer is satisfied that all work has been completed. After the ramp meter has been placed in operation, the contractor, in coordination with the system integrator, shall demonstrate that all equipment furnished and installed by the Contractor operates with all software and firmware as specified.

After successful completion of the test procedure, each ramp meter assembly shall go through a burn-in period for 30 consecutive days of normal ramp metering operations. During the burn-in period, the Contractor shall ensure that all Contractor-supplied equipment operates without failures of any type. If any equipment component malfunctions or fails to provide the specified functionality during the 30-day burn-in period, the Contractor shall replace or repair the defective equipment within 48 hours of notification by the Engineer.

After the malfunctioning component(s) have been repaired or replaced to the satisfaction of the Engineer, the Contractor shall begin a new 30-day burn-in period. The new 30-day burn-in period shall apply only to equipment components supplied by the Contractor. In the event of a failure or malfunctioning of equipment furnished by others which prevents the 30-day burn-in test from continuing, the Engineer will suspend the burn-in test and resume when the other equipment failures are corrected.

940.3.07 Contractor Warranty and Maintenance

Not applicable

940.3.08 Training

Not applicable

940.4 Measurement

The Department will pay all costs of coordination with and integration of the project into NaviGator under the integration pay item when the pay item is included in the Contract. The integration pay item is measured as a lump sum for all supplies, materials and subsistence it requires.

When the integration pay item is not included in the Contract, all costs of coordination with and integration of the project into NaviGator with all supplies, materials and subsistence it requires shall be included in other Contract items. The Department will make no separate payment for integration.

940.4.01 Limits

Not applicable

940.5 Payment

The Department will pay for integration that is complete, in place and accepted by the Department. Payment is full compensation for the work.

Payment for Section 940 is made under:

Item No. 940	Integration	Lump Sum
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— or —

Not applicable [when the Integration pay item is not included on the job.]

940.5.01 Adjustments

Not applicable

First Use: February 10, 2012
Revised: March 9, 2012
(DESIGN BUILD)

**DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA**

SPECIAL PROVISION

P.I. No.: 0010290 & 0010311

Fulton County

Forsyth County

SECTION 999 – DESIGN-BUILD PROJECT

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999.1 GENERAL DESCRIPTION

A. PI No. 0010290 Project Location: The location of the construction work included in this Project is shown in the Costing Plans. This Project is located at the SR 400/McFarland Parkway Interchange in Forsyth County, GA. The project consists of the extension of the third northbound lane along SR 400 from McFarland Parkway to the Big Creek Bridge. This project also includes restriping of the third northbound lane from just north of McGinnis Ferry Road to McFarland Parkway.

PI No. 0010311 Project Location: The location of the construction work included in this Project is shown in the Costing Plans. This Project is located at the SR 400/Abernathy Road Interchange in the City of Sandy Springs, Fulton County, GA. The project consists of the construction of a two-lane northbound entrance ramp and auxiliary lane.

B. Design-Build Concept: The Contractor and a design consultant (or design consultant team) will work together to design and build the Project. The design consultant will either be acting as a subconsultant to the Contractor or as a joint-venture member with whom this agreement has been executed. In this document (Section 999), the words ~~“design consultant”~~ or ~~“design consultant team”~~ will refer to the consultant firm or consultant team acting as a subcontractor or joint-venture team member to the Contractor. The design consultant or design consultant team will not be required to fill out Department subcontractor forms for Department use.

The words ~~“Engineer”~~ (with a capital ~~“E”~~) will refer to those personnel of the Department that are acting in the capacity of an engineer for the Department. When the word ~~“engineer”~~ is used the designation will refer to those persons acting on behalf of the Contractor. The Department will have oversight responsibilities only, which include performing reviews and granting acceptance of the design work.

Notice to Proceed (NTP) 1 is the Department’s issuance of NTP for preliminary design activities. Title 23, CFR, Section 636.103 (23 CFR Section 636.103) defines preliminary design to include but is not limited to preliminary engineering and other activities and analyses, such as topographic surveys, metes and bounds surveys, geotechnical investigations, hydrologic analysis, hydraulic analysis, utility engineering, traffic studies, financial plans, revenue estimates, hazardous materials assessments, general estimates of the types and quantities of materials, and other work needed to establish the parameters for the final design. Prior to completion of the National Environmental Protection Act (GEPA) review process, any such preliminary engineering and other activities and analyses must not materially affect the objective consideration of alternatives in the GEPA review process.

NTP 2 is the Department’s issuance of NTP for final design activities. NTP 2 will not be issued prior to the GEPA approval. Title 23, CFR, Section 636.103 (23 CFR Section 636.103) defines final design as any design activities following preliminary design and expressly includes the preparation of final construction plans and detailed specifications for the performance of construction work.

NTP 3 is the Department’s issuance of NTP for land disturbing activities. Purchase of construction materials or rolling stock and project construction will not begin until issuance of NTP 3.

Ensure no land disturbing activities until the following have been accepted by the Department for the entire project or for any portion(s) of the project as approved by the Department; and the Department provides written authorization through the issuance of NTP 3:

- 1. Basis of Design**
- 2. Environmental certification**
- 3. Approved Permits (as applicable)**
- 4. Final construction plans**
- 5. Erosion Sedimentation and Pollution Control Plans**
- 6. Notice of Intent (NOI) submission to EPD**
- 7. QC/QA Plan**
- 8. Traffic Control Plan**
- 9. Utility Agreements, Utility Encroachment Permits, Utility Relocation Plans, and/or Contractor Certification of “No-Conflict”**

After the Department has provided written authorization and the final plans are Released for Construction, it shall be the Contractor’s responsibility to continue to properly coordinate the Work during the land disturbing phase(s) of the project including but not limited to right of way requirements, utility relocations, and/or environmental requirements. Any additional project costs involving subsequent utility relocations that is determined to be no fault of the Utility shall be at the Contractor’s cost with no additional cost to the Department. Any additional project costs associated with additional right of way or environmental impacts shall be at the Contractor’s cost with no additional cost to the Department.

Bids on the Project will reflect designing and constructing the Project as shown in the Scope (999.1.C) and close conformity to applicable portions of the Costing Plans. No additional design exceptions and no design variances will be assumed by the Contractor.

Ensure submission of the Basis of Design. The Basis of Design narrative will constitute the Contractor’s ownership of or modifications to the documents provided “for information only” (See 999.2.A) as well as a discussion of how this information will be utilized to develop the final design. Ensure submission of any proposed changes in the design including the justification for the changes.

The Contractor may propose alternative methods/solutions to the Project Scope once the Project is awarded. The proposal must meet the following criteria:

- no additional or increased costs,
- no extension in overall schedule (or specified milestones),
- no exceptions to specifications included in this contract,
- no reduction in scope.

Ensure alternatives are submitted to the Engineer in writing and include clear documentation background, reason for the change, and any potential cost and/or time savings. The Department will authorize changes in writing; the Department reserves the right to approve or deny the proposed changes.

Ensure use of those entities prequalified in related disciplines (design, traffic analysis, geotechnical, etc.) as presented in the Statement of Qualifications (SOQ). Revisions to the design and data-gathering elements of the team and/or the proposed assignments reflected in the SOQ require approval by the Engineer. Approval of any replacements in the team shall occur prior to the letting of the Project. All proposed changes to the team must be received prior to letting. Ensure all requests for changes are sent to the following contact:

Transportation Services Procurement Administrator
Georgia Department of Transportation
Office of Transportation Services Procurement
One Georgia Center,
600 West Peachtree Street, NW, Room 1920
Atlanta, GA 30308

Additional disciplines needed to meet the requirements of the special provisions for this Project not identified in the SOQ must meet GDOT prequalification as required and any applicable standards, policies or guidelines of the local, state or federal agencies or utility owners.

Any revisions to the design consultant team and/or the proposed assignments reflected in the SOQ after award of the contract shall be approved by the Department. Ensure all requests are submitted to the Department's Engineer for review and further handling for approval.

The work covered under this Specification includes the furnishing of all materials, labor, tools, equipment, and other incidental items for the designing, detailing, and construction of the Project contained in the Project Scope. Ensure all the improvements for this Project are within the right of way as included in the Costing Plans (See also 999.1.D Right of Way).

Information related to "existing conditions", as reflected in the Costing Plans Package, is for information only. The Contractor shall be aware existing conditions found in the Costing Plans Package may have changed since the field survey work and associated design efforts were completed. Verify all existing conditions. No claims will be considered due to decisions/assumptions made by the Contractor based on "existing conditions" reflected in the Costing Plans Package.

C. PI No. 0010290 General Project Scope: The Project includes the construction of an inside northbound lane from the McFarland Parkway with additional pavement to the Big Creek Bridge on SR 400. The project includes restriping the existing inside lane from near the McGinnis Ferry Road overpass to McFarland Parkway. The total project length is approximately 1.86 miles. Other scope items include:

1. Construct an inside northbound lane and shoulder from the McFarland Parkway to the Big Creek Bridge. Restripe the existing inside lane as a travel lane from near the McGinnis Ferry Road overpass to McFarland Parkway.
2. Ensure the installation of sign structures and all signing and marking in general conformance to the Costing Plans. Ensure signs and pavement markings along State Route 400 are installed in accordance with Department and 2009 MUTCD design guidelines, standards, and details (or most current edition). Remove and replace existing sign structures when new or replacement signs are installed.
3. Construct all lane and shoulder widths as shown in the Costing Plans Package.
4. Preformed Plastic Pavement Marking shall be used on all concrete roadways.
5. Grind all concrete pavement in the existing striped lane on SR 400 that is to be converted to a travel lane in accordance with Standard Specification 431, Grind Concrete Pavement.
6. Install asphaltic curb behind guardrail when the fill height exceeds 10 feet. When asphaltic curb is installed behind guardrail, ensure installation of concrete spillways with

concrete flumes to drain in accordance with the applicable standards, details and specifications.

7. It is the responsibility of the Contractor to verify all drainage elevations prior to construction activities.
8. It shall be the responsibility of the Contractor to clean out and remove debris from all drainage structures within the project limits.
9. Ensure existing pavement inside the construction limits no longer being used is obliterated, graded to drain and grassed.
10. Ensure the pavement design meets or exceeds the approved pavement design as follows:

Travel Lanes	
<u>Material</u>	<u>Spread Rate</u>
Jointed Plain PC Concrete Class III– 12” DEPTH	N/A
RECYCLED ASPH CONC 19 mm SUPERPAVE, GP 1 OR 2, INCL BITUM MATL & H LIME	330 lb/sy
GRADED AGGREGATE BASE – 12” DEPTH	N/A
Shoulders	
<u>Material</u>	<u>Spread Rate</u>
RECYCLED ASPH CONC 12.5 mm SUPERPAVE, GP 2 ONLY, INCL BITUM MATL & H LIME	165 lb/sy
RECYCLED ASPH CONC 19 mm SUPERPAVE, GP 1 OR 2, INCL BITUM MATL & H LIME	220 lb/sy
RECYCLED ASPH CONC 25 mm SUPERPAVE, GP 1 OR 2, INCL BITUM MATL & H LIME	440 lb/sy
GRADED AGGREGATE BASE – 10” DEPTH	N/A

11. Replace existing impacted facilities in kind or upgrade. Possible affected resources include, but are not limited to the following: GDOT ITS system, signing and marking, cable barrier, barrier wall, utilities, and any utility prescriptive access and ingress to easement or right of way.
12. The project is to be designed and constructed to avoid all conflicts with utilities.
13. When proposed utility work is to be done by the Contractor, the Contractor will perform work necessary to relocate utility facilities for those utilities the Contractor demonstrates are unavoidable. Utility relocation to be performed by the Contractor will be measured and paid for as Extra Work according to Subsection 109.05, “Extra Work.” No additional time will be considered for this work. The bidder’s attention is directed to each utility Memorandum of Understanding (MOU) and to Specification 999.3.D Utilities.
14. Provide 4 portable changeable message signs that can be used on both projects as directed by the Engineer.
15. Unsuitable materials, as determined by the Engineer, discovered in the field during construction will be removed and replaced as directed by the Engineer and will be measured as Subsection 210.4.C and paid for as Subsection 210.5.C, “Undercut Excavation”.

D. PI No. 0010311 General Project Scope: The Project includes the construction of a two-lane entrance ramp from north bound Abernathy Road and auxiliary lane. The total project length is approximately 0.75 miles. Other scope items include:

1. Widen existing SR 400 northbound on-ramp to two 12' lanes for the entire length of the Abernathy Road on-ramp.
2. Construct an auxiliary lane and shoulder along SR 400 from the end of proposed northbound on-ramp widening to approximately 600 feet north of the MARTA North Springs overpass. The auxiliary lane is to be constructed full width for the entire length as shown in the Costing Plans Package.
3. Construct all lane and shoulder widths as shown in the Costing Plans Package.
4. Preformed Plastic Pavement Marking with contrast shall be used on all concrete roadways.
5. All striping removal to be done by water blasting in accordance with Standard Specification 656, Removal of Pavement Markings.
6. Ensure the installation of sign structures and all signing and marking in general conformance to the Costing Plans. Ensure signs and pavement markings along State Route 400 are installed in accordance with Department and 2009 MUTCD design guidelines, standards, and details (or most current edition). Remove and replace existing sign structures when new or replacement signs are installed.
7. Ensure the pavement design meets or exceeds the approved pavement design as follows:

Travel Lanes and Shoulders	
<u>Material</u>	<u>Spread Rate</u>
Jointed Plain PC Concrete Class III– 12" DEPTH	N/A
RECYCLED ASPH CONC 19 mm SUPERPAVE, GP 1 OR 2, INCL BITUM MATL & H LIME	330 lb/sy
GRADED AGGREGATE BASE – 12" DEPTH	N/A

8. Install asphaltic curb behind guardrail when the fill height exceeds 10 feet. When asphaltic curb is installed behind guardrail, ensure installation of concrete spillways with concrete flumes to drain in accordance with the applicable standards, details and specifications.
9. Ensure existing pavement inside the construction limits no longer being used is obliterated, graded to drain and grassed.
10. It shall be the responsibility of the Contractor to clean out and remove debris from all drainage structures within the project limits.
11. The limited access fence within the project area shall not be disturbed.
12. Replace existing impacted facilities in kind or upgrade. Possible affected resources include, but are not limited to the following: GDOT ITS system, signing and marking, cable barrier, barrier wall, utilities, and any utility prescriptive access and ingress to easement or right of way.
13. The project is to be designed and constructed to avoid all conflicts with utilities.

14. When proposed utility work is to be done by the Contractor, the Contractor will perform work necessary to relocate utility facilities for those utilities the Contractor demonstrates are unavoidable. Utility relocation to be performed by the Contractor will be measured and paid for as Extra Work according to Subsection 109.05, ~~“Extra Work.”~~ No additional time will be considered for this work. The bidder’s attention is directed to each utility Memorandum of Understanding (MOU) and to Specification 999.3.D Utilities.
 15. Unsuitable materials, as determined by the Engineer, discovered in the field during construction will be removed and replaced as directed by the Engineer and will be measured as Subsection 210.4.C and paid for as Subsection 210.5.C, ~~“Undercut Excavation”~~.
- E. Right of Way:** Ensure designing and constructing the Project occurs within the existing Right of Way as designated in the Costing Plans. Field establish the limits of Right of Way by staking at a minimum spacing of 100 feet prior to construction and ensure no encroachments will occur as a result of construction.
- F. Environmental:** Ensure adherence to and provide all material, labor, equipment, and other incidentals required to adhere to the ~~“Commitments/Requirements”~~ applying to the Contractor, design or construction of the Project. Key words such as ~~“construction,” “contractor,” “work,”~~ etc., point to the areas for which the Contractor is responsible.
1. The Department is responsible for preparation and obtaining approval of the GEPA document and any Environmental Reevaluations from the US Army Corps of Engineers (USACE) since the Contractor is prohibited from being involved with the decision making responsibilities related to the GEPA process (23 CFR Ch 1, Section 636.109(b)(6)). In addition, the Contractor may make recommendations to the Department for consideration.
 2. The GEPA document includes an Environmental Commitments Table. The Contractor will adhere to all commitments included in the Environmental Commitments Table from the approved GEPA document. In the event that the Environmental Commitments Table for the approved GEPA document is different from the Commitments provided in Section 999.1.E, the Department will consider this a changed condition and therefore the Contractor (or the Department) will be entitled to an appropriate adjustment in contract price.
 3. The GEPA document and Special/Technical Studies are valid until project changes occur which would invalidate the original findings. Any and all design changes made by the Contractor, which are outside of the parameters of the approved Environmental documentation, may require one or more of the Special/Technical Studies (Air, Archaeology, Ecology, History, and Noise) to be updated. Please note, revising Special/Technical Studies may require review/approval coordination with the various agencies be reopened. Project changes would also require an Environmental Reevaluation of the GEPA document. Updates to the Special/Technical Studies and the Environmental Reevaluation will be completed by the Department. The Environmental Timeframe Matrix provides approximate timeframes for environmental approvals to assist the Contractor in scheduling.
 4. Provide to the Department project change information, revised/final plan sheets, and any additional work product that may need to be considered in the GEPA analysis, in order to update Special/Technical Studies and complete the Environmental Reevaluation.

5. To proceed to Construction, the Special/Technical Studies and the GEPA document must have addressed all project changes affecting environmental resources.
6. Once it has been determined the environmental documentation is accurate and all GEPA related tasks (such as approval of an Environmental Reevaluation, all Preconstruction Environmental Commitments, including, but not limited to receipt of all permits, variances, and the purchase of mitigation credits) have been completed the Department will issue an Environmental Certification which will be provided to the Contractor. **No land disturbing activities will take place until this certification or conditional certification is issued.**
7. Provide the proposed impacts to streams and wetlands, which include impacts resulting from utility relocations, and temporary and/or permanent impacts, resulting from construction of the Project.
8. Determine if the proposed design impacts waters of the US. If the proposed design impacts waters of the US then an application for the Section 404 Nationwide Permit to the US Army Corps of Engineers will be completed by the Contractor. The Contractor shall prepare the Section 404 Nationwide Permit application to the Department's satisfaction. The Department will transmit the Section 404 Nationwide Permit to the US Army Corps of Engineers. The Contractor shall be responsible for satisfactorily addressing the US Army Corps of Engineer's comments. It is anticipated that approximately 90 days will be required from the time the Department transmits an acceptable Section 404 Nationwide Permit application to receipt of agency approval. The Contractor is required to satisfactorily address the US Army Corp of Engineer's comments within 14 calendar days of receipt. If any additional impacts result from the Contractor's proposed design versus those in the most recent ecology addendum, then the Department will perform special studies which will require 90 additional days prior to the Department's submittal of permit documentation to the appropriate agency and will require the Department to complete a reevaluation. Once the Department receives an approved Section 404 Nationwide permit from the US Army Corps of Engineers, the Department will issue written notification to the Contractor that the Contractor shall then acquire all mitigation credits in the name of the Department as required under the approved permit. All mitigation credits obtained by the Contractor and applied to the Project shall be approved by the US Army Corps of Engineers. Upon satisfactory receipt of the Contractor's credit purchase, the Department will provide written authorization to work in jurisdictional Waters of the US in accordance with the permit conditions.
9. Verify the need for any Buffer Variances on this Project. Ensure the necessary design and construction needed to avoid or mitigate for the buffer(s) impact. If a Buffer Variance is identified then the Contractor is responsible for notifying the Department no later than the time of the preliminary plans submittal to the Department. Prepare the Buffer Variance application to the Department's satisfaction. The Department will transmit the Buffer Variance application to Georgia's Environmental Protection Division. Satisfactorily address Georgia's Environmental Protection Division comments. The Department anticipates approximately 120 days will be required from the time the Department transmits an acceptable Buffer Variance application to receipt of agency approval. Satisfactorily address the Georgia Environmental Protection Division's comments within 14 calendar days of receipt. The Buffer Variance cannot be granted prior to issuance of the Section 404 Nationwide permit.
10. Acquire all mitigation credits in the name of the Department as required under the approved permit. All mitigation credits obtained by the Contractor and applied to the project shall be approved by the USACE.

11. Erect orange barrier fencing within the Project area to establish and protect any Environmentally Sensitive Areas (ESA) within the Project to prevent any encroachment upon said area during construction activities. Within ESA buffers for which a variance was obtained, install orange barrier fence within the buffer at the limits of the construction for which the variance was obtained.
12. The following are Commitments/Requirements as stipulated by the DRAFT GEPA document, actual impact requirements may change per the final design:
 - a. Place historic boundaries on project plans.
 - b. Place all Waters of the US on project plans.
 - c. Label stream buffer on plans.
 - d. Including the following note on all plan sheets with affected resources: ~~–Stay Off~~".
 - e. Including the following note on all plan sheets with affected resources: ~~–Should construction on the McFarland overpass over SR 400 or construction with the culvert over Stream 1 occur, the GDOT project ecologist will be notified and special provisions for migratory birds be written~~".
 - f. Obtain an NPDES permit. The permit shall be acquired by the construction contractor following the award of the contract but prior to the start of construction.

Environmental Timeframe Matrix

Document/ Permit/ Authorization	Coordinating Agency	Materials Needed	Approval Time*	Additional Information	Expiration of Document/Permit/ Authorization
Special/Technical Studies and GEPA Environmental Reevaluation	State Historic Preservation Officer (SHPO) and United States Fish and Wildlife Service (USFWS)	<ol style="list-style-type: none"> The Contractor shall be required to provide to the Department project change information, revised/final plans, and any additional work product that may need to be considered in the GEPA analysis that are outside of the original parameters of the Special/Technical Studies and the GEPA document for updating of those documents. Approved Special/Technical Study Addendums provided to the Contractor by the Department, which have been updated with regard to any project changes or change in project impacts due to more detailed design plans. 	<ol style="list-style-type: none"> GDOT: to initiate Section 7 coordination w/ USFWS; USFWS: 30 days for Section 7; GDOT: 30 days, minimum, to draft Special/Technical Studies and an Environmental Reevaluation; SHPO/USFWS: 30 days to review Special Studies 	<ol style="list-style-type: none"> Section 7 concurrence from GDOT/USFWS will be required before the reevaluation can be submitted to GDOT. All preconstruction commitments on the green sheet will need to be completed or on track to be completed for the Environmental Reevaluation to be submitted to USACE for review. The Project cannot be Environmentally Certified for construction until <u>ALL</u> preconstruction commitments have been completed. 	<p>The Environmental Reevaluation is valid until project changes are made that could invalidate the document or affect any of the commitments included in the Environmental Reevaluation.</p> <p>Should changes occur during construction, Special/Technical Studies may need to be updated and a new Environmental Reevaluation would need to be approved.</p>
Section 404	US Army Corp of Engineers (USACE)	PCN, 8½" X 11" plans (includes cover sheet and construction plan sheets that show the impacted resource), Jurisdictional Determination request, and signed GEPA document	60 days	Mitigation for the freshwater wetland impacts requires approval from the USACE before work can begin.	In general, 2 years from date of letter unless under construction and then there is 12 additional months to complete the authorized activities; however, for this project, there will be three years from when the letter is issued to complete ALL authorized activities.
Buffer Variance	Georgia Environmental Protection Division (EPD)	Application, 11" X 17" plans (includes cover sheet and the individual E&S plans for the area(s) of the project requiring the variance, legal ad for newspaper	120 days	For the roadway buffer impacts, the design must follow the mitigation guidelines found on EPD's website. If the variance is being applied for under criterion "H", then the Section 404 permit is required before variance can be issued.	None unless there are changes in the plans that result in additional buffer impacts. At that time a revision to the existing variance would be needed.
State Waters Determination	EPD	Plan sheets	30 days	Required if any resources will have non-exempted buffer impacts and buffer status is unclear	None unless conditions change.

*Times are approximate

999.2 PLANS

- A. General:** The Costing Plans Package prepared on behalf of the Department includes multiple resources. Information will be made available to the short listed Contractors via a read only GDOT FTP site and is considered for information only. These resources are to be used in preparing the bid and corresponding technical proposal (refer to Special Provision Section 102—Bidding Requirements and Conditions and Special Provision Section 999.6 – Technical Proposal) for this Project. Notify the Department of any resource in error or that would cause the design (as presented in the Costing Plans Package) to not be constructible.

The Georgia Department of Transportation, in making this information available to Contractors, assumes no responsibility for its accuracy. No claim will be considered if the Contractor relies on this -For Information Only” data in its bidding or in its construction operations and finds that it is inaccurate. The Contractor’s attention is directed to Specifications 101.16 – CONTRACT and 102.05 – EXAMINATIONS OF PLANS, SPECIFICATIONS, SPECIAL PROVISIONS, AND SITE OF THE WORK.

Files will be posted 8 am the day of Project Advertisement. Check this site daily for possible updates.

1. Enter <ftp://dotpublic:dotoutside02@ftp.dot.state.ga.us>
2. Select DOTFTP link
3. Select Innovative Program Delivery link
4. Select Project Identification Number – 0010290 and 0010311
5. Select RFP link

The Read Me First file contains documentation for when new files are added.

999.3 DESIGN

A. General: Ensure the design of the complete Project. Ensure the design based on their specific knowledge, and engineering judgment in the preparation of the design for the Project.

1. **Measuring Units:** Ensure the Project is designed in **English** units of measurement.
2. **Design Software:** Design using Microstation in conjunction with CAiCE or InRoads in accordance with Department's Electronic Data Guidelines (EDG), most current version, found at:
<http://www.dot.state.ga.us/doingbusiness/PoliciesManuals/roads/Pages/default.aspx>.
3. **Design Scope of Services:** Prepare Plans in accordance with the Georgia Department of Transportation's instructions as to design criteria, procedures, and format as contained in this Special Provision and in accordance with, but not limited to the following reference materials current at the time of advertisement: A Policy On Design Standards Interstate System, GDOT Design Policy Manual, GDOT Signing and Marking Design Guidelines, GDOT Driveway and Encroachment Manual, AASHTO Roadside Design Manual, AASHTO Geometric Design of Highway and Streets, Manual on Uniform Traffic Control Devices (MUTCD), Georgia Manual on Drainage Design for Highways, Utility Accommodation Policy and Standards Manual, GDOT Bridge Design Memos and the Bridge and Structural Design Manual, and the Department's Current Plan Preparation Guide (PPG).

Current Department design manuals and guidelines may be found at: <http://www.dot.ga.gov/doingbusiness/PoliciesManuals/roads/Pages/default.aspx>. Ensure Project designers consider all elements of the design, including but not limited to roadway geometry, drainage requirements, traffic control during construction, erosion control, structural design, utility conflicts, signing and marking, and future maintenance requirements.

4. **Design Reviews:** The design is to be prepared under the direct supervision of licensed design professionals. A Professional Engineer licensed to practice engineering in the State of Georgia on the design team seals the final plans. The seal on the drawing represents certification the design meets all applicable codes and is of good engineering practice and standards. Check and certify the design.

The Department will establish dates and times for cursory reviews and will comment on design work, but will not require hold points on the design, review periods, or comment responses, except as noted otherwise. If at any time the Department determines the design work is not in conformance with the Department's standards, details, specifications, or good engineering practice, the Department reserves the right to stop work, at the Contractor's expense until a resolution of the issue(s) has occurred.

Submit construction documents (plans and specifications) shown in Table 4-1 to the Department for review and acceptance. Acceptance, disapprovals, or comments made by the Department will be provided in writing to the Contractor within the appropriate timeframes shown in Table 4-1.

No construction is to begin on any phase of the work prior to the Department authorizing the various component(s) of the plans as Released for Construction. Other items shall be submitted to the Department by the Contractor, if requested. After the Department has accepted the plans and has authorized them as Released for Construction, any requests for any subsequent plan/design changes and include necessary documentation which supports the reasoning behind the change request must be submitted to the Department. The Department must approve the requested change with written notice prior to its implementation as a plan revision and subsequent construction activity.

Facilitate monthly progress meetings at a venue and time determined convenient to the Department. The general purpose of these meetings are to update the Department staff on the status of design, current activities, issues, activities that the Department is currently performing, and other related matters that impact scope, schedule and budget. Provide the Engineer an agenda of items one week in advance of the meeting in order the Engineer may arrange for the various GDOT Office reviewer(s) to attend, if necessary. Other attendees include the Contractor, design consultant, the Department's Project Engineer and Project Manager. Provide a call in number and conferencing capabilities to allow others to participate at the Department's discretion. Publish meeting notes of those discussions within two weeks of their occurrence and sent to all attendees and others indicated by GDOT. Ensure the first of these monthly meetings occur at the conclusion of the initial preconstruction conference.

ABBREVIATIONS FOR TABLE 4.1

AR	As Required
FS	Full-size paper – meets GDOT Plan Presentation Guide
HC	Hard Copy – 8 ½ x 11 unless otherwise noted
HS	Half-size paper – meets GDOT Plan Presentation Guide
MS	Microstation File – Electronic
NTP	Notice to Proceed
PAS	Per Approved Schedule
PDF	Adobe PDF – One complete file and individual plan sheet files meets GDOT Electronic Plans Process

TABLE 4-1: REVIEWS

Submittal Description	Format	Quantity	Delivery Date*	Review Period*	Review Type	Comment
Basis of Design	HC, PDF	3, 1	NTP+7	7	Accepted by Engineer	
Schedule of Values	HC,PDF	3, 1	NTP + 14	7	Accepted by Engineer	
Schedule – including review times	HC, PDF	3, 1	NTP+14	14	Accepted by Engineer	
QC/QA Plan	HC, PDF	3, 1	NTP+14	7	Accepted by Engineer	
Worksite Utility Control Supervisor	HC, PDF	3, 1	PAS	14	Accepted by Engineer	
Worksite Erosion Control Supervisor Qualifications	HC, PDF	3, 1	PAS	14	Accepted by Engineer	
Traffic Control Supervisor Qualifications	HC, PDF	3, 1	PAS	14	Accepted by Engineer	
Construction Traffic Control Plan	FS, HS, PDF	3, 3, 1	PAS	21	See Specification 150	
Final Plans (including all roadway plan components, erosion control plans, signing and marking, lighting design, ITS, etc...)	FS, HS, PDF	2, 20, 1	PAS	21	Accepted by Engineer	
Notice of Intent (NOI) with final/signed Erosion Control Plans	HS, PDF	3, 1	PAS	NA	EPD letter stating plans do not contain deficiencies.	The Department will submit final/signed Erosion Control Plans to EPD for review prior to submittal of the NOI package to EPD. The Contractor will address any plan changes required by EPD and to EPD's satisfaction.
Geotechnical Reports	HC, PDF	2, 1	PAS	30	Accepted by Engineer	If required
Shop Drawings	FS	6	PAS	30	Accepted by Engineer	

TABLE 4-1: REVIEWS (Continued)

Submittal Description	Format	Quantity	Delivery Date*	Review Period*	Review Type	Comment
Released for Construction Plans	FS, HS, PDF	4, 20, 1	PAS	NA	NA	Contractor shall provide the Engineer with one HS set for a backcheck prior to Release for Construction authorization.
Plan Revisions During Construction	FS, HS, PDF	1, 3, 1	Per Occurrence	14	Accepted by Engineer	Clear and concise supporting documentation justifying reason for proposed revision to be included with submittal.
As-Built Plans	See 999.3.A.8	See 999.3.A.8	Project Completion (+30)	30	Accepted by Engineer	

*All days are –Calendar Days.”, as defined in section 101, Standard specifications

All Submittals shall be made directly to the Engineer. The Engineer shall provide submittals to the applicable GDOT Office Reviewer and/or other applicable entities as directed by the Engineer, unless otherwise noted or discussed with the Contractor. As accepted by the Engineer the Contractor may provide submittals to applicable offices for a concurrent review. **Hand-deliver submittals, track and regularly update the Engineer on review status.** In the event concurrent submittals are required, the –receipt” date shall be the date the last recipient receives the submittal and shall be the contractual begin date for the review. Unless a different review time is specified elsewhere in the contract, a period of **thirty (30) calendar days** from receipt to release of the submittal by the Department shall be allowed for the Department’s review. Engineer’s (Department’s) acceptance as to completeness is required for all reviews. All Contractors’ schedules shall reflect the review times contained within the specifications and contract. Engineer’s receipt of submittals will mark the beginning of the review period. All submittals by the Contractor shall be required to contain a statement certifying that no unapproved design-exceptions have been incorporated in the submittal. Up to date half-size sets of plans with the most current design and construction plans shall be made available to a distribution list made up of up to 20 individuals/offices at all times during this Project. Errors and omissions are the responsibility of the Contractor to correct and shall be at the Contractor’s expense.

Any submittal received by the Engineer after 12 PM (noon) shall be considered as being received the following business day.

Hold monthly progress meetings. Attendees shall include the Contractor, design consultant, the Department’s project engineer and design liaison, and may also include representatives from various Department Offices.

5. **Field Surveys:** Verify all provided survey data and update to current Electronic Data Guidelines (CAiCE). Provide terrain and drainage cross sections, pavement elevations, and drainage structure information for this Project. Provide all survey data noted in English units. All supplemental field survey information is to be completed in accordance to the *GDOT Automated Survey Manual*.
6. **Quality Control/Quality Assurance for Design:** The Department, except where noted otherwise, will have oversight responsibilities only and will not perform official reviews and approvals of design work. The Department will not take any approval or formal review actions on design issues except as noted herein or for deviations from the intended scope of the Project.

Employ only persons duly registered in Georgia in the appropriate category in responsible charge of supervision and design of the work; and further, employ only qualified, State of Georgia registered land surveyors in responsible charge of any survey work.

Use only a consultant design team prequalified by the Department in all applicable area classes as described in the SOQ. Should a member of the design consultant team need to be replaced, the Department must approve of the change prior to the Project letting. Failure to secure approval of the replacements prior to letting may result in the disqualification of the Contractor's bid.

Endorse all final reports, contract plans and survey data. These endorsements shall be made by a person(s) duly registered in the appropriate category by the Georgia State Board of Registration for Professional Engineers and Land Surveyors, being in the full employ of the Contractor and responsible for the work prescribed in the contract.

Authorized representatives of the Department may review and inspect the Project activities and data collected at all times. All reports, drawings, studies, specifications, estimates, maps and computations prepared by or for the Contractor shall be available to authorized representatives of both the Department for inspection and review. The Department's review comments are to be incorporated into the plans by the Contractor or as agreed. These changes shall not result in an increase in cost.

Before the start of the contracted design effort, develop and acquire the Department's approval for a QC/QA Plan to ensure all design documents are prepared in accordance with the Department's Plan Presentation Guide (PPG) for Microstation using good, prudent and generally accepted design and engineering practice. Also see the Department's Manual of Quality Standards for Consultant Services.

- a. Ensure the QC/QA Plan includes the following, which shall be considered minimum requirements:
 - 1) Quality control and quality assurance procedures for design documents specify measures to be taken by the Contractor to (A) ensure appropriate quality standards are specified and included in the design documents and to control deviations from such standards, being understood and agreed no deviations from such standards be made unless they have been previously accepted by the Department, and (B) for the selection of suitable materials and elements of the Work included in the Project.
 - 2) Quality control and quality assurance procedures for preparing and checking all plans, calculations, drawings and other items submitted to ensure they are independently checked and back-checked in accordance with generally accepted engineering practices, by experienced engineers. Identify the originator, checker and back-checker on the cover of all submittals. Ensure the Plans, reports and other documents are stamped, signed and dated by the responsible Georgia Registered Engineer where required under the contract

documents, generally accepted engineering practices or by applicable laws. The Contractor will submit a certified statement to ensure all reviews have been made.

- 3) Procedures for coordinating work performed by different persons within the same area, in an adjacent area or in related tasks shall ensure that conflicts, omissions or misalignments do not occur between drawings or between the drawing and specifications. These procedures allow for the coordination of the review, approval, release, distribution and revision of documents involving such persons.
- 4) All the persons proposed to be responsible for Quality Control and Quality Assurance procedures are to be listed as follows: Discipline, Name, Qualifications, Duties, Responsibilities and Authorities.
- 5) Designate all key personnel performing Quality Control and Quality Assurance functions as such and will not be assigned to perform conflicting duties.

All plan related documents produced during the contract period are to be maintained by the Contractor for the duration of the Contract organized, indexed and delivered to the Department (1) upon Final Acceptance of the Project or (2) even if incomplete, within seven (7) days of receipt of request from the Department. These documents include, but not limited to, the following items: design criteria, reports and notes, calculations, drawings, schematics, supporting materials, statement regarding accomplishment of reviews and others.

7. **Released for Construction:** Upon the Contractor's satisfactory completion of the items listed in 999.1.B, and upon written authorization from the Department the plans are Released for Construction, stamp each plan sheet with "Released for Construction" and include the authorization date. The Released for Construction plans are the official plans used for construction of the Project.
8. **As-Built Plans:** Upon completion of the Project construction, provide a complete As-Built set of plans to the Department in the following formats:
 - a. Two (2) CD-ROMs or DVDs containing:
 - 1) all electronic design files, electronic calculations, etc.
 - 2) .pdf images of each plan sheet – one sheet per file with each sheet numbered
 - 3) .pdf containing the entire plan set with each sheet numbered
 - b. One (1) hard copy of the design databook, and drainage calculations
 - c. Two (2) full-size set of bond prints
 - d. Two (1) half-size set of bond prints
 - e. Provide a revised estimated summary of quantities and detailed estimate in the final As-Built plans

Ensure all production and delivery of materials needed for Department review. Both a member of the design team, who is a Professional Engineer, and a member who is a Registered Surveyor, licensed to practice engineering in the State of Georgia shall seal the As-Built plans.

9. **Ownership of Documents:** The Contractor agrees all reports, drawings, studies, specifications, survey notes, estimates, maps, computations, computer files and other data, prepared by or for the Project under the terms of this Agreement and delivered to the Department become and remain the property of the Department. The Department will have the right to use this information without restriction or limitation and without compensation to the Contractor other than provided for in this agreement.

Any use of these documents by the Department on any Project other than this one will be done without warranty by the Contractor/Design Consultant Team.

- 10. Insurance:** In addition to the insurance requirements covered elsewhere, provide insurance coverage of the following types and amounts:

 - a. Valuable Papers: Insurance in an amount sufficient to assure the restoration of any plans, drawings, field notes or other similar data relating to the work covered by the Project is required. Insurance is to be maintained in full force and effect during the life of this Agreement.
 - b. Professional Liability (Errors and Omissions): Insurance in an amount not less than one million dollars (\$1,000,000) per claim (with a maximum of \$250,000 deductible per claim) during the agreement term and for a period of at least five (5) years after this Agreement is closed is required. Such a policy is to cover all of the Contractor's professional liabilities, whether occasioned by the Contractor, his employees, subcontractors or other agents, arising out of services performed under or in accordance with this Agreement.
- 11. Publication and Publicity:** Articles, papers, bulletins, reports or other materials reporting the plans, progress, analyses or results and findings of the work conducted under this Agreement shall not be presented publicly or published without prior approval in writing from the Department. All releases of information, findings and recommendations shall include a disclaimer provision to be included in all published reports on the cover and title page in the following form:

–The opinions, findings and conclusions in the publication are those of the author(s) and not necessarily those of the Department of Transportation, State of Georgia or the Federal Highway Administration.”

Any information concerning the Project, including conduct, results or data gathered or processed, released by the Contractor without prior approval from the Department will constitute grounds for termination without indemnity to the Contractor. Information released by the Department or by the Contractor with prior written approval is to be regarded as public information and no longer subject to the restrictions of this Agreement. Information required to be released by the Department under the Georgia Open Records Act, Section 50-18-70, et seq., O.C.G.A., the restrictions and penalties mentioned set forth herein shall not apply. Any request for information directed to the Contractor, pursuant to the Georgia Open Records Act, is to be redirected to the Department for further action.
- 12. Copyrighting:** The Contractor and the Department agree any papers, interim reports, forms and other material which are a part of work under this Agreement are to be deemed a ~~work~~ made for hire”, as such term is defined in the Copyright Laws of the United States. As a ~~work~~ made for hire”, all copyright interests in said works shall vest in the Department upon creation of the copyrightable work. If any papers, interim reports, forms or other material which are a part of work under the Agreement are deemed by law not to be a ~~work~~ made for hire”, any copyright interests of the Contractor are hereby assigned completely and solely to the Department. Publication rights to any works produced under this Agreement are reserved by the Department.
- 13. Patent Rights:** If patentable discoveries or inventions result from work described herein, all rights accruing from such discoveries or inventions are the sole property of the Contractor. However, the Contractor agrees to and does hereby grant to the Department, an irrevocable, non-exclusive, non-transferable and royalty-free license to practice each invention in the manufacture, use and disposition according to law of any article or material and in use of any method that may be developed as a part of the work under this Agreement.

B. Roadway

1. Preparation of Construction Plans

- a. **General Criteria:** Ensure and use the most current design criteria at the time of advertisement, as determined by the Department, American Association of State Highway and Transportation Officials (AASHTO) Design Manuals for Arterial Streets, Rural, Urban and Interstate Highways, including those standards adopted by AASHTO and approved by the Secretary of Commerce, as provided by Title 23, United States Code, Section 109 (b), with the Department's Standards, Procedures, Plans, Specifications and Methods, with Federal Highway Administration procedures relating to plan review and approval, and shall produce plans in accordance therewith.
- b. **Design Specifications and Guidelines:** Design for roadways and intersections shall be in accordance with the current edition of AASHTO Design Specifications; the 1994 edition of the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals; and AASHTO Roadside Design Guide and the Department of Transportation Standard Specifications for Construction of Roads and Bridges, 2001 Edition, the 2008 Supplemental Specifications modifying the 2001 Standard Specifications. Design and plan preparation shall be in accordance with the FHWA Federal-Aid Policy Guide. Plan and specifications shall conform to the requirements of the Highway Capacity Manual.

Design for work to conform to AASHTO design standards for the appropriate classification and speed design.

Utilize the following references as a minimum in the development of this Project in addition to the references listed above

- 1) Electronic Data Guidelines (EDG) – current version at time of advertisement
- 2) Plan Presentation Guide (PPG) – current version at time of advertisement
- 3) GDOT Design Policy Manual – current version at time of advertisement
- 4) Manual on Uniform Traffic Control Devices (MUTCD) by the U.S. Department of Transportation, Federal Highway Administration –“FHWA” – current version at time of advertisement
- 5) Manual on Drainage Design for Highways by the Georgia Department of Transportation - current version at time of advertisement
- 6) Roadway and Bridge Standard Plans as of July, 2006 by the GDOT Road and Airport Design Office. Design and plan preparation in accordance with the Certification Acceptance authorized by 23 USC 117(a) for Administering Federal Aid Projects Not On Interstate System, dated June 1, 1990.
- 7) Guidelines for Processing Design Data in InRoads Design Guidelines (<http://www.dot.state.ga.us/doingbusiness/PoliciesManuals/roads/software/Page/INROADS.aspx>) – current version at time of advertisement.
- 8) GDOT Construction Standards and Details - current versions at time of advertisement
- 9) Pay Item Index by the GDOT State Transportation Office Engineer - current version at time of advertisement
- 10) Utility Accommodation Policy and Standards by the GDOT Utilities Office - current version at time of advertisement

- 11) GDOT Signing and Marking Design Guidelines – current version at time of advertisement
- 12) Traffic Signal Design Guidelines – current versions at time of advertisement
- 13) A Policy On Design Standards for Interstate System – current version at time of advertisement.
- 14) Other manuals of guidance which are standard procedures of the Department, (signal design, signing and markings, etc).

The above list is not intended to be all-inclusive. All references to the “current version” shall mean those in effect at time of advertisement. Any current editions written in metric units ensure “soft converted” to U.S. Standards Units. Any rounding shall be to the dimension that shall increase safety.

- c. **Erosion and Sediment Control Sheets:** No land disturbing activities until the Control of Soil Erosion and Sedimentation Plan has been accepted by the Engineer; the NOI has been successfully submitted to EPD by the Department; EPD has issued a letter to the Department indicating the plan “does meet” current NPDES requirements; and the required waiting period of 14 days is observed.

Prepare the Erosion Sedimentation and Pollution Control Plans (ESPCP) in accordance with current Department practice, and in accordance with the requirements set forth in the NPDES General Permit No. GAR1000002 [August 2008]. NPDES General Permit Guidance may be found at: <http://www.dot.state.ga.us/doingbusiness/PoliciesManuals/roads/Pages/DesignPolicies.aspx>.

In addition, design the plans in accordance with the current version of Georgia Soil and Water Conservation Commission’s Manual for Erosion and Sediment Control in Georgia (Green Book).

Erosion and Sediment Control Plans detail the erosion control devices to be used. These devices include, but are not limited to, sediment traps, floating silt retention barriers, check dams, silt fence (types A, B & C), bailed straw ditch checks, brush barriers and slope drains. Additional plan sheets are required for each stage of construction. Additional plan sheets are also required to illustrate phased installation of erosion measures. All required sediment and erosion control items, including but not limited to installation and maintenance, shall be paid for under CONSTRUCTION COMPLETE.

As contained within the Department’s standard ESPCP General Notes (dated 8-26-2008 or more current), remove all references to the following statement: “The Erosion Sedimentation and Pollution Control Plan (ESPCP) is provided by the Department.”

C. Utilities

1. Coordination Responsibilities: The Contractor shall have the responsibility of coordinating the project construction with all utilities that may be affected. Coordinating responsibilities shall include but not be limited to the following:
 - a. The Contractor shall initiate early coordination with all Utility Owners located within the project limits. The Contractor shall be responsible for the cost of Utility Coordination. Coordination shall include, but shall not be limited to, contacting each Utility Owner to advise of the proposed project.
 - b. The Contractor shall design the project to avoid conflicts with utilities.
 - c. Progress meetings will be held at the project location if requested by either the Contractor or the Department. Attendees shall include the Contractor, design consultant, the Department's project engineer and design liaison, and may also include a representative from various Department Offices.
 - d. The Contractor shall coordinate and conduct a preliminary review meeting with the Utility Owners to assess and explain the impact of the project. The Department's Project Manager, District Construction Engineer (or designee), and District Utilities Engineer (or designee) shall be included in this meeting. Knowledge of the project environmental "Commitments/ Requirements" (Green Sheets) is essential for Utility Owners during their design phase. The Contractor shall provide the Environmental Commitments table, and any re-evaluation with all Utility Owners.
 - e. During the construction of the project, the Contractor shall designate, prior to beginning any work, a Worksite Utility Coordination Supervisor (WUCS) who shall be responsible for initiating and conducting utility coordination meetings and accurately recording and reporting the status of all work around existing utilities. Also, the WUCS shall prepare an Emergency Response Plan for the purpose of planning, training, and communicating among the agencies responding to the emergency. The WUCS shall be the primary point of contact between all of the Utility companies, the Contractor and the Department. The WUCS shall recommend the rate of reoccurrence for utility coordination meetings and the Engineer will have the final decision on the regularity for utility coordination meetings. The WUCS shall contact each of the utility companies for the purpose of obtaining information. The WUCS shall notify the appropriate utility company and/or utility subcontractors and the Department of the status of controlling items of relocations and adjustment milestones as they are completed.
 - 1) Qualifications: The WUCS shall be an employee of the Prime Contractor, shall have at least one year experience directly related to highway and utility construction in a supervisory capacity and have a complete understanding of the Georgia Utilities Protection Center operations, and shall be knowledgeable of the High-voltage Safety Act and shall be trained on the Georgia Utility Facility Protection Act (GUFPA). The Department does not provide any training on GUFPA but will maintain a list of the Georgia Public Service Commission certified training programs developed by other agencies. Currently the following companies offer approved GUFPA training programs:

Associated Damage Consultants
Phone: 706.234.8218 or 706.853.1362

Georgia Utility Contractors Association
Phone: 404.362.9995

Georgia Utilities Protection Center
Phone: 678.291.0631 or 404.375.6209

H B Training & Consulting
Phone: 706.619.1669 or 877.442.4282 (Toll Free)

The Prime Contractor is responsible for obtaining the GUFPA training for their employees.

Questions concerning the Georgia Public Service Commission GUFPA training program shall be directed to:

Georgia Public Service Commission
244 Washington St. SW
Atlanta, GA 30334-5701
404.463.9784

- 2) Ticket Status: During the utility coordination meetings the WUCS shall collect and maintain the Ticket Status information to determine the status of all locate requests within the project limits. This information will be used to assure those planning to use mechanized equipment to excavate or to work within the project limits are prepared to begin work when they have reported or estimated beginning work. At points where the Contractor's or utility company's operations are adjacent to or conflict with overhead or underground utility facilities, or are adjacent to other property, damage to which might result in considerable expense, loss, or inconvenience, work shall not commence until all arrangements necessary for the protection thereof have been made.
- 3) Notice: The names of known utility companies and the location of known utility facilities will be shown on the Plans, or listed in the Overhead/Subsurface Utility Engineering Investigation if performed or in the Special Provisions; and the WUCS shall give 24-hour notice to such utility companies before commencing work adjacent to said utility facilities which may result in damage thereto. The WUCS shall further notify utility companies of any changes in the Contractor's work schedules affecting required action by the utility company to protect or adjust their facilities. Notice to the utility companies by the Department of the Award of Contract, under Subsection 105.06, shall not be deemed to satisfy the notice required by this paragraph. Furthermore, this 24-hour notice shall not satisfy or fulfill the requirements of the Contractor as stated in Chapter 9 of Title 25 of the Official Code of Georgia Annotated, known as the "Georgia Utility Facility Protection Act".
- 4) Emergency Response Plan: The WUCS shall prepare and submit to the Department an Emergency Response Plan no later than 30 days prior to beginning construction. The WUCS shall clearly mark and highlight the gas, water and other pressurized pipeline shut-off valves and other utility services including overhead switch locations on the utility plans; and prepare a chart to indicate the location of each site (Street address or intersections), the utility company or operator of the facility with emergency contact information and the working condition of the device to facilitate prompt shut-off. The WUCS shall post the Emergency Response Plan in an area readily accessible to the Department. In the event of interruption to gas, water or other utility services as a result of accidental breakage or as a result of being exposed or unsupported, the WUCS shall promptly notify the appropriate emergency officials, the Georgia Utilities Protection Center and the appropriate utility facility company or operator, if known. Until such time as the damage has been repaired, no person shall

engage in excavating or blasting activities that may cause further damage to the utility facility.

- f. In addition to the above, the Contractor shall comply with all provisions set forth under subsection 107.21 of the Georgia Department of Transportation's Specifications, Construction of Transportation Systems, current edition.

2. General

- a. By Georgia Statutes, utilities whether public or privately owned, aerial or underground, are permitted by the Department and local governments to be accommodated within the public right of way. To this end, the Contractor shall avoid all utilities. Design/construction techniques that avoid utility conflicts may involve increased upfront costs; however, those costs are offset by savings during construction, in addition to the total cost savings for the project (the Department or local government) and the respective utility owners.
- b. Additional guidance for accommodating utilities within the right of way are given in the AASHTO publications: A Guide for Accommodating Utilities within Highway Right of Way, A Policy on Geometric Design of Highways and Streets; the TRB publication: Policies for Accommodation of Utilities on Highway Rights-of-Way; and in GDOT's Utility Accommodation Policy and Standards, current edition.
- c. The Utility Plans are used as the primary tool to identify and resolve utility related conflicts/issues prior to beginning the construction of a project. Also, when these plans are properly prepared as indicated in this Special Provision; they will support the vital coordination required between the Contractor and the Utility Owner during construction. Existing utility information shown on the utility Plans for this project have been obtained from an Overhead / Subsurface Utility Engineering (SUE) Investigation (please refer to 999.3.D.3.c. for more information on SUE). This existing utility information has been provided by the Department for the Contractor's use in the design and construction of this project. Known utilities and contacts are shown in the Costing Plans Package.
- d. Utility plan sheets are comprised of completed roadway plan sheets but shall contain more detailed information featuring existing and proposed utility facilities. Specific requirements for Utility Plans are detailed below.

3. Required Information

a. Preliminary Utility Plans

- 1) Preliminary Utility Plan sheets are typically comprised of preliminary roadway plan sheets with the inclusion of all existing utility facility locations (overhead & underground) found within a project's limits. Determining the location of the existing utilities has been accomplished through an Overhead/Subsurface Utility Engineering Investigation. The Department has classified these "degrees of effort" into different Quality Levels of information. Refer to 999.3.D.3.c. for definitions of these Quality Levels. Quality Level B Overhead/Subsurface Utility Engineering has been completed for this project and provided as part of the Costing Plans Package.
- 2) Preliminary Utility Plans shall be produced and used by the Contractor in the utility coordination/relocation design activities outlined here and under Section 999.1. The following minimum information shall be shown on the Preliminary Utility Plans:
 - (a) Construction centerlines with Project stations and begin/end Project limits.
 - (b) Curb and gutter or edge of pavement (proposed and existing)

- (c) Road and street names
 - (d) Existing and Required Right of Way limits, property lines, environmentally sensitive area limits, and property owners.
 - (e) All proposed and existing easements (including existing utility easements)
 - (f) Proposed and existing drainage structures/features (excluding drainage text)
 - (g) Proposed construction limits (C/F lines)
 - (h) Topographical planimetrics (i.e. existing buildings/structures, existing tree/vegetation limits)
 - (i) All proposed bridges, walls, other structures and landscape hardscapes.
 - (j) All proposed and existing strain poles (signal, sign, lighting)
 - (k) Utilities Legend
 - (l) Miscellaneous General Notes
 - (m) Existing overhead and underground utilities found within the Project's limits, including size and material if known.
 - (n) Sanitary sewer manhole top, and invert elevations. Sanitary Sewer pipe flow directions
 - (o) Railroad mainline and spur tracks with their respective property/easement limits
 - (p) Project Survey control point locations
 - (q) SUE specific General Notes
 - (r) Utility Pole Data Table
 - (s) SUE investigation Limit of study
 - (t) SUE Quality Level B information (As provided as part of the Costing Plans Package)
- b. Final Utility Plans
- 1) The Final Utility Plans shall clearly show all existing utilities on the plans and clearly indicate all existing utilities are ~~To~~ "To Remain".
 - 2) In addition to the information required for the Preliminary Utility Plans, the Final Utility Plans shall include: Miscellaneous General Notes required for coordination of utility facilities with roadway construction.
- c. Overhead/Subsurface Utility Engineering (SUE) Investigations
- The existing utility information provided in these investigations includes a description of what ~~degree~~ "degree of confidence" there is in its accuracy. The Department has classified these ~~degrees~~ "degrees of confidence" into different Quality Levels of information:
- 1) Quality Level "D" Information - Information obtained solely from a review of utility records and field verification. The comprehensiveness and accuracy of such information is highly limited. Even when existing information for a utility in a particular area is accurate, there are often other underground systems that are not shown on any records. Quality Level ~~D~~ "D" may be appropriately used early in the development of a Project to determine the presence of utilities.
 - 2) Quality Level "C" Information - Information obtained to augment Quality Level ~~D~~ "D" information. This involves topographic surveying of visible, above-ground utility

features (e.g., poles, hydrants, valve boxes, circuit breakers, etc.) and entering the topographic data into the CADD system. Since aerial utility lines are not surveyed, information provided for these facilities is considered Quality Level -G" also. Quality Level -G" may be appropriately used early in the development of a Project and shall provide better data than Quality Level -D" information alone. Designers shall be very cautious when working on Projects using information for underground utilities that is based only on Quality Levels -D" and -G" locates.

- 3) Quality Level "B" Information - Information obtained through the use of designating technologies (e.g., geophysical prospecting technologies). This is an application using scanning technologies, most of which have very specific capabilities. Applying a variety of techniques is essential to the process of preparing a comprehensive horizontal map of utilities and other underground structures on the site. Designating technologies are capable of providing good horizontal information.
- 4) Quality Level "A" (Test Hole) Information - Provides the highest level of accuracy of utility locations in three dimensions. This level may apply manual, mechanical or nondestructive (e.g., vacuum excavation) methods to physically expose utilities for measurement and data recording. Quality Levels -B", -G", and -D" locates are incorporated in Quality Level -A" locates.

4. Sheet Layout

- a. The Contractor needs to ensure that any information and graphic data that is not necessary to depict the disposition of utilities found within the project's limits is removed by turning off the appropriate CADD levels(s) on which the data is stored. This will help ensure that information pertinent to utility facilities can be clearly seen in the Utility Plan sheets. Examples of extraneous information would be items such as horizontal curve data, superelevation data, roadway dimensions, misc. text, etc. All background information such as pavement limits, existing structures, etc. shall be screened back. Also, the Contractor shall ensure all text, line work, details, and symbols are clear and legible when plans are reduced to 1/2 size.
- b. In order to maintain plan clarity all applicable general notes, tables, and the Utility Legend shall be placed separately from the Utility Plan sheets. A Utility Plan -Cover Sheet" shall be provided for both preliminary and final Utility Plans. A recommended example utility sheet schedule is provided below:
 - 1) Utility Sheet 1 (Cover Sheet) - Utility General Notes, Utility Legend, Miscellaneous Details
 - 2) Utility Sheet 2 (required as needed) - Additional Miscellaneous Details, Pole Data Table
 - 3) Utility Plan Sheets - Utilities shown in plan view with respect to Project.
 - 4) Miscellaneous Utilities Sheets - Miscellaneous proposed utility details (as required).

The above sheet schedule shall also be generally followed for all separate utility relocation plans (i.e. water & sewer plans) included in the Project plans.

5. Underground Operations:

- a. Anytime underground operations, excavations or digging of any type is contemplated in the general area of the any utility facility, -Excavating" means any operation by which the level or grade of land is changed or earth, rock, or other material below existing grade is moved and includes, without limitation, grading, trenching, digging, ditching, auguring, scraping, directional boring, and pile driving. Georgia Utility

Facility Protection Act (GUFPA) mandates that, before starting any mechanized digging or excavation work, you must contact Georgia 811 at least 48 hours but no more than 10 working days in advance to have utility lines marked. Damage and Emergency locate request may be called in 24 hours a day, seven days a week. The Contractor shall take reasonable action to determine the location of any underground utility facilities in and near the area for which signs are to be placed. In addition to establishing the approximate location of all utility facilities, the Contractor shall be required to fully expose the facility to verify its horizontal and vertical location, if underground operations are contemplated within the Tolerance Zone, which is defined to mean the approximate location of underground utility facilities defined as a strip of land at least 4 feet wide, but not wider than the width of the underground facility plus 2.0 feet on either side of the outside edge of such facility based upon the markings made by the locators. Excavation within the tolerance zone requires extra care and precaution. The contractor shall avoid interference with underground utility facilities within the tolerance zone by utilizing such precautions that include, but are not limited to, hand excavation, vacuum excavation methods, and visually inspecting the excavation while in progress until clear of the existing marked facility; The Contractor shall provide, during and following excavation for placement of any signs, such support for existing underground utility facilities in and near the excavation as may be reasonably necessary for the protection of such facilities unless otherwise agreed to by GDOT and the Utility owner. The Contractor shall backfill all excavations in such manner and with such materials as may be reasonably necessary for the protection of existing underground utility facilities in and near the area of excavation or sign placement.

<http://www.dot.ga.gov/doingbusiness/consultants/Pages/default.aspx>

999.4 CONSTRUCTION

Ensure the Project is constructed as per the Project scope and as per the accepted Released for Construction plans in accordance with the Specifications. No construction will begin on any phase of the work prior to the Department providing written authorization to the Contractor to begin land disturbing activities. Deliver all subsequent Released for Construction plans at least 24 (twenty four) hours before commencing land disturbing activities. All plans submitted to the Area Office for use on construction shall include all applicable Standards and Details required in the Work.

Construction includes, but is not limited to, the following:

- A. All clearing and grubbing and grading required in accordance with Sections 201, 202, 205, 206, 208 and 209. All necessary grading and drainage (All proposed pipes shall be concrete) to construct the subgrades, including the removal and replacement of unsuitable material, shoulders and incidental work to include furnishing borrow pits, waste disposal areas and hauling borrow and waste materials as required. Ensure the removal and replacement of unsuitable material.
- B. All necessary culvert extensions include removal and replacement of headwalls, aprons and rip-rap. Ensure existing culverts are analyzed for structural sufficiency for new fills. Where the existing culvert is not structurally sufficient, remove the deficient portion of the culvert and replace utilizing appropriate excavation and shoring as needed. Alternate methods of construction may be submitted to the Department for approval.
- C. All necessary base construction, milling, leveling, asphalt paving and concrete paving to construct the pavement structure.
- D. Removal of all curbs, drainage structures, pavements, bases and sub-bases, or other obstructions within the rights of way as necessary to construct the roadway section.
- E. All signing, interstate signage including sign structures, signalization, pavement marking, raised pavement markers, and guardrail.
- F. Ensure storing of any equipment and materials on the Project outside of the active clear zone.
- G. Errors and omissions are the responsibility of the Contractor to correct and at the expense of the Contractor.
- H. No existing materials removed from the Project shall be reused. Coordinate the removal and disposal of all Signing and ATMS items with the Department. All remaining material shall be disposed of properly by the Contractor in accordance with all Local, State and Federal laws.
- I. Preparation of As-Built Construction Plans.

999.5 MEASUREMENT AND PAYMENT

The Work required under this Specification will not be measured separately for payment unless otherwise specified. Payment for the items listed below, complete and accepted, will be made at the Lump Sum price bid. Payment shall be full compensation for furnishing all materials, labor, tools, equipment, superintendence, mailing charges, removal and replacement of unsuitable material and other incidentals. It shall also be made for performing all work specified, including but not limited to, designing, detailing, producing construction plans (preliminary and final, electronic and hard copy), meeting with the Department, processing the NOI and complete construction.

Provide a detailed estimate with the Release for Construction plans. Partial payments of the Lump Sum price will be made on monthly statements based on an accepted schedule of values and detailed estimate. Develop a schedule of values with sufficient breakdown for each of the following items:

- P.I. No. 0010290
 - DESIGN COMPLETE
 - CONSTRUCTION COMPLETE
- P.I. No. 0010311
 - DESIGN COMPLETE
 - CONSTRUCTION COMPLETE

Include the schedule for values a rational basis for partial payments of the Lump Sum bid based on the completed portion of the item and definitive activities. Submit the schedule for values to the Engineer. No payments will be made until the schedule of values is accepted.

No payment for mobilization will be made until the Department issues written authorization that plans are released for construction. Payment for mobilization shall not exceed 2.5% of the overall bid price for Construction Complete. The Contractor shall submit a detailed breakdown of mobilization in the proposed schedule of values for acceptance.

Contractor shall work with the Engineer to establish estimated earthwork, asphalt, and concrete quantities, as this will determine the frequency of required testing by the Department.

At the end of each calendar month, provide the Department with a certification showing the percent complete for each item of work. Include a breakdown and supporting documentation, to include the Design Consultant’s monthly invoice, in sufficient detail to substantiate the percent complete certified.

Payment shall be made under:

P.I. No. 0010290

Item 999-2010 - DESIGN COMPLETE	per Lump Sum
Item 999-2015 - CONSTRUCTION COMPLETE	per Lump Sum

P.I. No. 0010311

Item 999-2010 - DESIGN COMPLETE	per Lump Sum
Item 999-2015 - CONSTRUCTION COMPLETE	per Lump Sum

999.6 TECHNICAL PROPOSAL

Submit a Technical Proposal that includes, but is not limited to, the detailed project schedule (including all submittals shown in Table 4-1 of Special Provision 999, estimated review periods, and any other areas of Special Provision 999 where submittals are mentioned), any permit requirements, expected Released for Construction date, total contract time, mobilization assumptions, as well as construction staging assumptions. Clearly document all assumptions in this technical proposal. There are no page limit restrictions for the technical proposal.

GDOT maintains the ability to review and approve all project submittals after award. Selection of a Proposer will not imply acceptance or approval of Proposer's Preliminary Baseline Schedule or any assumptions.

Submit to the Department seven (7) copies of the technical proposal and one (1) cd or dvd containing an electronic copy of the technical proposal in a sealed envelope so marked as to identify its contents without being opened.

If the "Technical Proposal" is not received by the GADOT Office of Construction Bidding Administration, Room 1113, by no later than 11:00 a.m. on the day of the Bid Opening, the Bid will be subject to rejection.

March 27, 2012

AMENDMENT TO ADVERTISED CONTRACT

CONTRACT I.D. NUMBER: B34313-12-000-0
GEORGIA PROJECT NUMBER: 0010290, 0010311
PCN: 0010290.01000, 0010311.01000
COUNTY: FORSYTH, FULTON
AMENDMENT NUMBER: 1
LETTING DATE: APRIL 20, 2012
LETTING NUMBER: 025

THE FOLLOWING CHANGES ARE HEREBY MADE TO THIS CONTRACT. THE BIDDER IS RESPONSIBLE FOR MAKING ANY NECESSARY CHANGES IN INK IN THE PROPOSAL. BIDDER SHALL ACKNOWLEDGE THIS AMENDMENT BY CHECKING THE APPROPRIATE SPACE ON THE PROPOSAL SIGNATURE PAGE.

1. **Delete** Supplemental Specification Section 107-Legal Regulations and Responsibility to the Public, with a revised date of October 5, 2007 from the proposal, **and Substitute** the attached Supplemental Specification Section 107-Legal Regulations and Responsibility to the Public, 3 pages, dated February 17, 2012, in the proposal.

DAVID E. HOGE
STATE TRANSPORTATION OFFICE ENGINEER

DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA
SUPPLEMENTAL SPECIFICATION

Section 107—Legal Regulations and Responsibility to the Public

Delete Subsection 107.23 and substitute the following:

107.23 Environmental Considerations

A. Construction

Erosion control measures shall be installed, to the greatest practical extent, prior to clearing and grubbing. Particular care shall be exercised along stream buffers, wetlands, open waters and other sensitive areas to ensure that these areas are not adversely affected.

Construction equipment shall not cross streams, rivers, or other waterways except at temporary stream crossing structures approved by the Engineer.

Construction activities within wetland areas are prohibited except for those within the construction limits as shown on the Plans and as specified in [Subsection 107.23.E](#).

All sediment control devices (except sediment basins) installed on a project shall, as a minimum, be cleaned of sediment when one half the capacity, by height, depth or volume, has been reached. Sediment basins shall be cleaned of sediment when one-third the capacity by volume has been reached.

B. Bridge Construction Over Waterways

Construction waste or debris, from bridge construction or demolition, shall be prevented from being allowed to fall or be placed into wetlands, streams, rivers or lakes.

Excavation, dewatering, and cleaning of cofferdams shall be performed in such a manner as to prevent siltation. Pumping from cofferdams to a settling basin or a containment unit will be required if deemed necessary by the Engineer.

Operations required within rivers or streams, i.e. jetting or spudding, shall be performed within silt containment areas, cofferdams, silt fence, sediment barriers or other devices to minimize migration of silt off the project.

C. Borrow and Excess Material Pits

Specific written environmental clearance from the Engineer will be required for any sites not included in the Plans as excess material or borrow areas. No work other than testing shall be started at any potential excess material or borrow site not shown on the plans prior to receiving said environmental clearance from the Engineer.

The Engineer will require a written notice from the Contractor requesting environmental clearance studies and written permission from the property owner at least six weeks prior to intended use of the site. The Department will not begin studies on such sites before a Notice to Proceed is issued.

The Engineer will inform the Contractor in writing as to the granting or denial of environmental clearance. If denied, the Contractor may, at no expense to the Department, seek to obtain permits or pursue other remedies that might otherwise render the site(s) acceptable.

Sites included in the Plans have environmental clearance and shall be used only for the purpose(s) specified in the Plans or other contract documents. Should the Contractor wish to expand or utilize said sites for any purpose other than that provided for in the Plans or other contract documents, specific written environmental clearance as noted above shall be obtained.

D. Control of Pollutants

Pollutants or potentially hazardous materials, such as fuels, lubricants, lead paint, chemicals or batteries, shall be transported, stored, and used in a manner to prevent leakage or spillage into the environment. The Contractor shall also be responsible for proper and legal disposal of all such materials.

Equipment, especially concrete or asphalt trucks, shall not be washed or cleaned-out on the Project except in areas where unused product contaminants can be prevented from entering waterways.

E. Temporary Work in Wetlands Outside of the Construction Limits within the Right-of-Way and Easement Areas

Temporary work in wetlands (that are not delineated with orange barrier fence) will be subject to the following requirements:

1. Temporary work in wetlands shall be accomplished by using temporary structures, timber, concrete, soil with geotextile fabric, or other suitable matting. The area shall not be grubbed.
2. Soil matting shall be protected from erosion in accordance with the Specifications.
3. Whenever temporary work is required in Saltwater Marsh Wetlands, all temporary structures and/or matting shall be removed in their entirety prior to Final Acceptance of the Project. Matted and compressed soils shall be backfilled to their original ground elevation with material meeting the requirements of [Section 212 – Granular Embankment](#).
4. Whenever temporary work is required in Freshwater Wetlands, all temporary structures and/or matting (exclusive of soil matting to be retained in the final roadway section) shall be removed in their entirety prior to Final Acceptance of the Project.

Once the temporary materials have been removed, the area shall be covered by Excelsior or Straw blankets according to [Section 713](#) of the Specifications. The grassing and ground preparation referenced in [Subsection 713.3.03, "Preparation"](#), will not be applicable to this Work.

5. The Engineer shall be notified so that a field inspection may be conducted to certify that the temporary materials were properly removed and that the area was properly restored. The Contractor shall be responsible for any corrective action required to complete this Work.
6. There will be no separate measurement or payment for this Work. The cost associated with this work shall be included in the overall Bid submitted.

F. Environmentally Sensitive Areas

Some archaeological sites, historic sites, wetlands, streams, stream and pond buffers, open waters and protected animal and plant species habitat within the existing/required Right-of-Way and easement areas may be designated as ENVIRONMENTALLY SENSITIVE AREAS (ESAs). These areas are shown on the applicable Plan sheets and labeled "ESA" (e.g. ESA – Historical Boundary, ESA – Wetland Boundary). The Department may require that some ESAs or portions thereof be delineated with orange barrier fence. The Contractor shall install, maintain, and replace as necessary orange barrier fence at ESAs as delineated in the Plan sheets.

The Contractor shall not enter, disturb, or perform any construction related activities, other than those shown on the approved plan sheets within areas designated as ESAs including ESAs or portions thereof not delineated with orange barrier fence. This includes but is not limited to the following construction activities: clearing and grubbing; borrowing; wasting; grading; filling; staging/stockpiling; vehicular use and parking; sediment basin placement; trailer placement; and equipment cleaning and storage. Also, all archaeological sites, historic sites, wetlands, streams, stream and pond buffers, open waters, and protected animal and plant species habitat that extend beyond the limits of existing/required Right-of-Way and easement areas shall be considered ESAs and the Contractor shall not perform any construction related activities (such as those listed above) within these areas or make agreements with property owners to occupy

these areas for construction related activities (such as those listed above). The Contractor shall make all construction employees aware of the location(s) of each ESA and the requirement to not enter or otherwise disturb these areas.

If the Contractor is found to have entered an ESA, either within or outside the project area, for any purpose not specifically shown on the approved plan sheets, the Department may, at its discretion, issue a stop work order for all activities on the project except erosion control and traffic control until such time as all equipment and other items are removed and the ESA is restored to its original condition.

However, should damage to an ESA occur as a result of the Contractor's action in violation of this section, and notwithstanding any subsequent correction by the Contractor, the Contractor shall be liable for any cost arising from such action, including but not limited to, the cost of repair, remediation of any fines, or mitigation fees assessed against the Department by another government entity.

Office of Environmental Services

March 30, 2012

AMENDMENT TO ADVERTISED CONTRACT

CONTRACT I.D. NUMBER: B34313-12-000-0
GEORGIA PROJECT NUMBER: 0010290, 0010311
PCN: 0010290.01000, 0010311.01000
COUNTY: FORSYTH, FULTON
AMENDMENT NUMBER: 2
LETTING DATE: APRIL 20, 2012
LETTING NUMBER: 025

THE FOLLOWING CHANGES ARE HEREBY MADE TO THIS CONTRACT. THE BIDDER IS RESPONSIBLE FOR MAKING ANY NECESSARY CHANGES IN INK IN THE PROPOSAL. BIDDER SHALL ACKNOWLEDGE THIS AMENDMENT BY CHECKING THE APPROPRIATE SPACE ON THE PROPOSAL SIGNATURE PAGE.

1. Special Provision Section 102-Bidding Requirements and Conditions, dated August 22, 2011, Subsections 102.06 and 102.07; **Delete** the wording "Prime Contractor's Work Authorization Certification/E Verify Certification" **and Substitute** "Georgia Security and Immigration Compliance Act Affidavit".

DAVID E. HOGE
STATE TRANSPORTATION OFFICE ENGINEER

April 11, 2012

AMENDMENT TO ADVERTISED CONTRACT

CONTRACT I.D. NUMBER: B34313-12-000-0
GEORGIA PROJECT NUMBER: 0010290, 0010311
PCN: 0010290.01000, 0010311.01000
COUNTY: FORSYTH, FULTON
AMENDMENT NUMBER: 3
LETTING DATE: APRIL 20, 2012
LETTING NUMBER: 025

THE FOLLOWING CHANGES ARE HEREBY MADE TO THIS CONTRACT. THE BIDDER IS RESPONSIBLE FOR MAKING ANY NECESSARY CHANGES IN INK IN THE PROPOSAL. BIDDER SHALL ACKNOWLEDGE THIS AMENDMENT BY CHECKING THE APPROPRIATE SPACE ON THE PROPOSAL SIGNATURE PAGE.

- *****
1. **Delete** Proposal Pages 115, 116, and 117, Special Provision Section 153-Field Engineer's Office, from the proposal.
 2. Proposal Page 646, Special Provision Section 999-Design Build Project, Subsection 999.1.C; **Delete** Subsection 999.1.C.10. **and Substitute** the following:
 10. Ensure the pavement design is as follows:

Travel Lanes	
<u>Material</u>	<u>Spread Rate</u>
Jointed Plain PC Concrete Class III- 12" DEPTH	N/A
RECYCLED ASPH CONC 19 mm SUPERPAVE, GP 1 OR 2, INCL BITUM MATL & H LIME	330 lb/sy
GRADED AGGREGATE BASE - 12" DEPTH	N/A
Shoulders	
<u>Material</u>	<u>Spread Rate</u>
RECYCLED ASPH CONC 12.5 mm SUPERPAVE, GP 2 ONLY, INCL BITUM MATL & H LIME	165 lb/sy
RECYCLED ASPH CONC 19 mm SUPERPAVE, GP 1 OR 2, INCL BITUM MATL & H LIME	220 lb/sy
RECYCLED ASPH CONC 25 mm SUPERPAVE, GP 1 OR 2, INCL BITUM MATL & H LIME	440 lb/sy
GRADED AGGREGATE BASE - 10" DEPTH	N/A

AMENDMENT TO ADVERTISED CONTRACT (continued):

3. Proposal Page 647, Special Provision Section 999-Design Build Project, Subsection 999.1.C; **Delete** Subsection 999.1.D.7 **and Substitute** the following:

7. Ensure the pavement design is as follows:

Travel Lanes and Shoulders	
<u>Material</u>	<u>Spread Rate</u>
Jointed Plain PC Concrete Class III- 12" DEPTH	N/A
RECYCLED ASPH CONC 19 mm SUPERPAVE, GP 1 OR 2, INCL BITUM MATL & H LIME	330 lb/sy
GRADED AGGREGATE BASE - 12" DEPTH	N/A

4. Proposal Pages 655 and 656, Special Provision Section 999-Design Build Project, Subsection 999.3.A.4; **Delete** "Table 4-1: Reviews", **and Substitute** the attached revised "Table 4-1: Reviews".

DAVID E. HOGE
STATE TRANSPORTATION OFFICE ENGINEER

REVISED
TABLE 4-1: REVIEWS

Submittal Description	Format	Quantity	Delivery Date*	Review Period*	Review Type	Comment
Basis of Design	HC, PDF	3, 1	NTP+7	7	Accepted by Engineer	
Schedule of Values	HC, PDF	3, 1	NTP + 14	7	Accepted by Engineer	
Schedule -- including review times	HC, PDF	3, 1	NTP+14	14	Accepted by Engineer	
QC/QA Plan	HC, PDF	3, 1	NTP+14	7	Accepted by Engineer	
Worksite Utility Control Supervisor	HC, PDF	3, 1	PAS	14	Accepted by Engineer	
Worksite Erosion Control Supervisor Qualifications	HC, PDF	3, 1	PAS	14	Accepted by Engineer	
Traffic Control Supervisor Qualifications	HC, PDF	3, 1	PAS	14	Accepted by Engineer	
Construction Traffic Control Plan	FS, HS, PDF	3, 3, 1	PAS	21	See Specification 150	
Final Plans (including all roadway plan components, erosion control plans, signing and markings, lighting design, ITS, etc...)	FS, HS, PDF	2, 20, 1	PAS	14	Accepted by Engineer	
Notice of Intent (NOI) with final/signed Erosion Control Plans	HS, PDF	3, 1	PAS	NA	EPD letter stating plans do not contain deficiencies.	The Department will submit final/signed Erosion Control Plans to EPD for review prior to submittal of the NOI package to EPD. The Contractor will address any plan changes required by EPD and to EPD's satisfaction.
Geotechnical Reports	HC, PDF	2, 1	PAS	30	Accepted by Engineer	If required
Shop Drawings	FS	6	PAS	30	Accepted by Engineer	