Control	**0047-06-158, ETC.**
Project	**STP 2024(041)MM**
Highway	**US 75**
County	**COLLIN, ETC.**

ADDENDUM ACKNOWLEDGMENT

Each bidder is required to acknowledge receipt of an addendum issued for a specific project. This page is provided for the purpose of acknowledging an addendum.

FAILURE TO ACKNOWLEDGE RECEIPT OF AN ADDENDUM WILL RESULT IN THE BID NOT BEING READ.

In order to properly acknowledge an addendum place a mark in the box next to the respective addendum.

ADDENDUM NO. 1 ☐

ADDENDUM NO. 2 ☐

ADDENDUM NO. 3 ☐

ADDENDUM NO. 4 ☐

ADDENDUM NO. 5 ☐

In addition, the bidder by affixing their signature to the signature page of the proposal is acknowledging that they have taken the addendum(s) into consideration when preparing their bid and that the information contained in the addendum will be included in the contract, if awarded by the Commission or other designees.

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Control	**0047-06-158, ETC.**
Project	**STP 2024(041)MM**
Highway	**US 75**
County	**COLLIN, ETC.**

PROPOSAL TO THE TEXAS TRANSPORTATION COMMISSION

2014 SPECIFICATIONS

WORK CONSISTING OF HIGHWAY IMPROVEMENT

COLLIN COUNTY, TEXAS, Etc.

The quantities in the proposal are approximate. The quantities of work and materials may be increased or decreased as considered necessary to complete the work as planned and contemplated.

This project is to be completed in 780 working days and will be accepted when fully completed and finished to the satisfaction of the Executive Director or designee.

Provide a proposal guaranty in the form of a Cashier's Check, Teller's Check (including an Official Check) or Bank Money Order on a State or National Bank or Savings and Loan Association, or State or Federally chartered Credit Union made payable to the Texas Transportation Commission in the following amount:

ONE HUNDRED THOUSAND (Dollars) **($100,000)**

A bid bond may be used as the required proposal guaranty. The bond form may be detached from the proposal for completion. The proposal may not be disassembled to remove the bond form. The bond must be in accordance with Item 2 of the specifications.

Any addenda issued amending this proposal and/or the plans that have been acknowledged by the bidder, become part of this proposal.

By signing the proposal the bidder certifies:

1. the only persons or parties interested in this proposal are those named and the bidder has not directly or indirectly participated in collusion, entered into an agreement or otherwise taken any action in restraint of free competitive bidding in connection with the above captioned project.
2. in the event of the award of a contract, the organization represented will secure bonds for the full amount of the contract.
3. the signatory represents and warrants that they are an authorized signatory for the organization for which the bid is submitted and they have full and complete authority to submit this bid on behalf of their firm.
4. that the certifications and representations contained in the proposal are true and accurate and the bidder intends the proposal to be taken as a genuine government record.

- **Signed: ****

(1) _____ (2) _____ (3) _____

Print Name:

(1) _____ (2) _____ (3) _____

Title:

(1) _____ (2) _____ (3) _____

Company:

(1) _____ (2) _____ (3) _____

- Signatures to comply with Item 2 of the specifications.

**Note: Complete (1) for single venture, through (2) for joint venture and through (3) for triple venture.

*** When the working days field contains an asterisk (*) refer to the Special Provisions and General Notes.**

NOTICE TO CONTRACTORS

ANY CONTRACTORS INTENDING TO BID ON ANY WORK TO BE AWARDED BY THIS DEPARTMENT MUST SUBMIT A SATISFACTORY "AUDITED FINANCIAL STATEMENT" AND "EXPERIENCE QUESTIONNAIRE" AT LEAST TEN DAYS PRIOR TO THE LETTING DATE.

UNIT PRICES MUST BE SUBMITTED IN ACCORDANCE WITH ITEM 2 OF THE STANDARD SPECIFICATIONS OR SPECIAL PROVISION TO ITEM 2 FOR EACH ITEM LISTED IN THIS PROPOSAL.

TEXAS DEPARTMENT OF TRANSPORTATION

BID BOND

KNOW ALL PERSONS BY THESE PRESENTS,

That we, (Contractor Name) _____

_____

Hereinafter called the Principal, and (Surety Name) _____

_____

a corporation or firm duly authorized to transact surety business in the State of Texas, hereinafter called the Surety, are held and firmly bound unto the Texas Department of Transportation, hereinafter called the Obligee, in the sum of not less than two percent (2%) of the department's engineer's estimate, rounded to the nearest one thousand dollars, not to exceed one hundred thousand dollars ($100,000) as a proposal guaranty (amount displayed on the cover of the proposal), the payment of which sum will and truly be made, the said Principal and the said Surety, bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the principal has submitted a bid for the following project identified as:

Control	**0047-06-158, ETC.**
Project	**STP 2024(041)MM**
Highway	**US 75**
County	**COLLIN, ETC.**

NOW, THEREFORE, if the Obligee shall award the Contract to the Principal and the Principal shall enter into the Contract in writing with the Obligee in accordance with the terms of such bid, then this bond shall be null and void. If in the event of failure of the Principal to execute such Contract in accordance with the terms of such bid, this bond shall become the property of the Obligee, without recourse of the Principal and/or Surety, not as a penalty but as liquidated damages.

Signed this _____ Day of _____ 20_____

By: _____

(Contractor/Principal Name)

_____

(Signature and Title of Authorized Signatory for Contractor/Principal)

*By: _____

(Surety Name)

_____

(Signature of Attorney-in-Fact)

*Attach Power of attorney (Surety) for Attorney-in-Fact

Impressed Surety Seal Only

This form may be removed from the proposal.

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BIDDER'S CHECK RETURN

IMPORTANT

The space provided for the return address must be completed to facilitate the return of your bidder's check. Care must be taken to provide a legible, accurate, and complete return address, including zip code. A copy of this sheet should be used for each different return address.

NOTE

Successful bidders will receive their guaranty checks with the executed contract.

RETURN BIDDERS CHECK TO (PLEASE PRINT):

Control	**0047-06-158, ETC.**
Project	**STP 2024(041)MM**
Highway	**US 75**
County	**COLLIN, ETC.**

IMPORTANT

PLEASE RETURN THIS SHEET IN ITS ENTIRETY

Please acknowledge receipt of this check(s) at your earliest convenience by signing below in longhand, in ink, and returning this acknowledgement in the enclosed self addressed envelope.

Check Received By: _____ Date:_____

Title: _____

For (Contractor's Name): _____

Project _____ County_____

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NOTICE TO THE BIDDER

In the space provided below, please enter your total bid amount for this project. Only this figure will be read publicly by the Department at the public bid opening.

It is understood and agreed by the bidder in signing this proposal that the total bid amount entered below is not binding on either the bidder or the Department. It is further agreed that **the official total bid amount for this proposal will be determined by multiplying the unit bid prices for each pay item by the respective estimated quantities shown in this proposal and then totaling all of the extended amounts.**

$_____

Total Bid Amount

Control 0001-03-030
Project STP 2000(938)HES
Highway SH 20
County EL PASO

ALT	ITEM	DESC	SP	Bid Item Description	Unit	Quantity	Bid Price	Amount	Seq
	104	509		REMOV CONC (SDWLK)	SY	266.400	$10.000	$2,664.00	1

EXAMPLE

Total Bid Amount _____$2,664.00_____

Signed _____
Title _____
Date _____

Additional Signature for Joint Venture:

Signed _____
Title _____
Date _____

EXAMPLE OF BID PRICES SUBMITTED BY COMPUTER PRINTOUT

EXAMPLES

BID PRICES SUBMITTED BY HAND WRITTEN FORMAT

ALT	ITEM-CODE			UNIT BID PRICE ONLY WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC NO	S.P. NO.				
	190	026		RED OAK 1 1/2 - 1 3/4 GAL BB	EA	9.000	1
				EXAMPLE: One hundred fifty DLRS and No CENTS			

Unit price for each plant in place

	249	014		FLEX BASE(DEL)(DENSCOT)(TY A GR4 CL2)	TON	56,787.00	14
				EXAMPLE: Seven DLRS and Fifty three CENTS			

Unit price for each ton of Flexible Base

	430	001	001	CL A CONC FOR EXT STR (CULV)	CY	45.000	27
				EXAMPLE: Three hundred five DLRS and No CENTS			

Unit price for each cubic yard of Concrete

	610	007	001	RDWY ILL ASSEM(TY ST 50T-8-8)(.4 KW)S	EA	13.000	7
				EXAMPLE: Fourteen hundred sixteen DLRS and Thirty seven CENTS			

Unit price of each Roadway Illumination Assembly

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ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	100	6002		PREPARING ROW DOLLARS and CENTS	STA	907.400	1
	104	6010		REMOVING CONC (RIPRAP) DOLLARS and CENTS	CY	53.000	2
	104	6023		REMOVING CONC (CTB) DOLLARS and CENTS	LF	73,493.000	3
	161	6017		COMPOST MANUF TOPSOIL (4") DOLLARS and CENTS	SY	6,583.000	4
	162	6002		BLOCK SODDING DOLLARS and CENTS	SY	6,583.000	5
	164	6051		DRILL SEED (TEMP)(WARM OR COOL) DOLLARS and CENTS	SY	6,333.000	6
	168	6001		VEGETATIVE WATERING DOLLARS and CENTS	MG	1,940.000	7
	360	6007	001	CONC PVMT (CONT REINF - CRCP) (13") DOLLARS and CENTS	SY	132.000	8
	361	6007		FULL - DEPTH REPAIR CRCP (13") DOLLARS and CENTS	SY	256.200	9
	361	6052		FULL - DEPTH REPAIR CRCP (8"-14") DOLLARS and CENTS	SY	178.000	10
	403	6001		TEMPORARY SPL SHORING DOLLARS and CENTS	SF	3,615.200	11
	416	6004		DRILL SHAFT (36 IN) DOLLARS and CENTS	LF	1,741.000	12

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	416	6005		DRILL SHAFT (42 IN) DOLLARS and CENTS	LF	21.000	13
	416	6006		DRILL SHAFT (48 IN) DOLLARS and CENTS	LF	87.000	14
	416	6007		DRILL SHAFT (54 IN) DOLLARS and CENTS	LF	20.000	15
	416	6020		DRILL SHAFT (SIGN MTS) (36 IN) DOLLARS and CENTS	LF	18.000	16
	416	6026		DRILL SHAFT (HIGH MAST POLE) (60 IN) DOLLARS and CENTS	LF	1,809.000	17
	416	6029		DRILL SHAFT (RDWY ILL POLE) (30 IN) DOLLARS and CENTS	LF	8.000	18
	420	6037	001	CL C CONC (COLUMN) DOLLARS and CENTS	CY	11.900	19
	420	6043	001	CL C CONC (FOOTING) DOLLARS and CENTS	CY	89.300	20
	420	6049	001	CL C CONC (CRASHWALL) DOLLARS and CENTS	CY	214.700	21
	420	6068	001	CL C CONC (SIGN COLUMN) DOLLARS and CENTS	CY	395.100	22
	420	6134	001	CL C CONC (SIGN FOOTING) DOLLARS and CENTS	CY	81.900	23
	420	6154	001	CL C CONC (HPC) DOLLARS and CENTS	CY	60.200	24

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	432	6001		RIPRAP (CONC)(4 IN) DOLLARS and CENTS	CY	631.500	25
	432	6045		RIPRAP (MOW STRIP)(4 IN) DOLLARS and CENTS	CY	524.000	26
	451	6025		RETROFIT RAIL (TY SSTR)(HPC) DOLLARS and CENTS	LF	4,339.000	27
	500	6001		MOBILIZATION DOLLARS and CENTS	LS	1.000	28
	502	6001	008	BARRICADES, SIGNS AND TRAFFIC HAN-DLING DOLLARS and CENTS	MO	30.000	29
	506	6020	005	CONSTRUCTION EXITS (INSTALL) (TY 1) DOLLARS and CENTS	SY	1,320.000	30
	506	6024	005	CONSTRUCTION EXITS (REMOVE) DOLLARS and CENTS	SY	1,320.000	31
	506	6038	005	TEMP SEDMT CONT FENCE (INSTALL) DOLLARS and CENTS	LF	7,612.000	32
	506	6039	005	TEMP SEDMT CONT FENCE (REMOVE) DOLLARS and CENTS	LF	7,612.000	33
	506	6041	005	BIODEG EROSN CONT LOGS (INSTL) (12") DOLLARS and CENTS	LF	5,327.000	34
	506	6043	005	BIODEG EROSN CONT LOGS (REMOVE) DOLLARS and CENTS	LF	5,327.000	35
	512	6005		PORT CTB (FUR & INST)(F-SHAPE)(TY 1) DOLLARS and CENTS	LF	124,080.000	36

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	512	6029		PORT CTB (MOVE)(F-SHAPE)(TY 1) DOLLARS and CENTS	LF	58,350.000	37
	512	6053		PORT CTB (REMOVE)(F-SHAPE)(TY 1) DOLLARS and CENTS	LF	124,080.000	38
	514	6003		PERM CTB (SGL SLOPE) (TY 3) (42) DOLLARS and CENTS	LF	9.000	39
	514	6005		PERM CTB (SGL SLOPE) (TY 1) (48) DOLLARS and CENTS	LF	67,073.000	40
	514	6007		PERM CTB (SGL SLOPE) (TY 3) (48) DOLLARS and CENTS	LF	1,648.000	41
	514	6015		PERM CTB (F-SHAPE) (TY 3) DOLLARS and CENTS	LF	9.000	42
	514	6022		PERM CTB(SGL SLOPE)(TY 1)(48)(HPC) DOLLARS and CENTS	LF	1,273.000	43
	514	6036		PERM CTB (TRAN SSCB TO SSTR) (MOD) DOLLARS and CENTS	LF	280.000	44
	514	6047		PERM CTB (SGL SLOPE)(TY 1)(TRANSITION) DOLLARS and CENTS	LF	760.000	45
	533	6005		RUMBLE STRIPS (SHOULDER) CONCRETE DOLLARS and CENTS	LF	124,867.000	46
	540	6002	001	MTL W-BEAM GD FEN (STEEL POST) DOLLARS and CENTS	LF	9,525.000	47
	540	6006	001	MTL BEAM GD FEN TRANS (THRIE-BEAM) DOLLARS and CENTS	EA	10.000	48

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	540	6016	001	DOWNSTREAM ANCHOR TERMINAL SECTION DOLLARS and CENTS	EA	42.000	49
	542	6001		REMOVE METAL BEAM GUARD FENCE DOLLARS and CENTS	LF	1,400.000	50
	542	6002		REMOVE TERMINAL ANCHOR SECTION DOLLARS and CENTS	EA	7.000	51
	542	6004		RM MTL BM GD FENCE TRANS (THRIE-BEAM) DOLLARS and CENTS	EA	1.000	52
	544	6001		GUARDRAIL END TREATMENT (INSTALL) DOLLARS and CENTS	EA	43.000	53
	544	6003		GUARDRAIL END TREATMENT (REMOVE) DOLLARS and CENTS	EA	15.000	54
	545	6003		CRASH CUSH ATTEN (MOVE & RESET) DOLLARS and CENTS	EA	6.000	55
	545	6005		CRASH CUSH ATTEN (REMOVE) DOLLARS and CENTS	EA	39.000	56
	545	6019		CRASH CUSH ATTEN (INSTL)(S)(N)(TL3) DOLLARS and CENTS	EA	39.000	57
	610	6006		REMOVE RD IL ASM (BRIDGE MOUNT) DOLLARS and CENTS	EA	24.000	58
	610	6007		REMOVE RD IL ASM (SHOE-BASE) DOLLARS and CENTS	EA	4.000	59
	610	6008		REMOVE RD IL ASM (CTB MOUNT) DOLLARS and CENTS	EA	134.000	60

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	610	6009		REMOVE RD IL ASM (TRANS-BASE) DOLLARS and CENTS	EA	99.000	61
	610	6010		REMOVE RD IL ASM (U/P) DOLLARS and CENTS	EA	126.000	62
	610	6101		REPLACE LUMINAIRE W/LED (150W EQ) DOLLARS and CENTS	EA	28.000	63
	610	6102		REPLACE LUMINAIRE W/LED (250W EQ) DOLLARS and CENTS	EA	6.000	64
	610	6103		REPLACE LUMINAIRE W/LED (400W EQ) DOLLARS and CENTS	EA	46.000	65
	610	6104		IN RD IL (U/P) (TY 1) (150W EQ) LED DOLLARS and CENTS	EA	72.000	66
	610	6216		IN RD IL (TY SA) 40T-10 (250W EQ) LED DOLLARS and CENTS	EA	1.000	67
	613	6005		HI MST IL POLE (150 FT)(80 MPH) DOLLARS and CENTS	EA	45.000	68
	613	6007		HI MST IL POLE (175 FT)(80 MPH) DOLLARS and CENTS	EA	9.000	69
	614	6007		LED HI MST IL ASM (6 FIXT)(ASYM)(TY A) DOLLARS and CENTS	EA	46.000	70
	614	6011		REPLC LED HI MST IL(6 FIXT)(ASYM)(TY A) DOLLARS and CENTS	EA	6.000	71
	614	6014		LED HI MST IL AM(6 FIXT)ASYM(TY A)SHLD DOLLARS and CENTS	EA	8.000	72

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	617	6002		TEMP RD IL (RD IL ASM) DOLLARS and CENTS	MO	15.000	73
	618	6023		CONDT (PVC) (SCH 40) (2") DOLLARS and CENTS	LF	53,687.000	74
	618	6024		CONDT (PVC) (SCH 40) (2") (BORE) DOLLARS and CENTS	LF	32,158.000	75
	618	6027		CONDT (PVC) (SCH 40) (2 1/2") DOLLARS and CENTS	LF	2,400.000	76
	618	6028		CONDT (PVC) (SCH 40) (2 1/2") (BORE) DOLLARS and CENTS	LF	890.000	77
	618	6029		CONDT (PVC) (SCH 40) (3") DOLLARS and CENTS	LF	26,556.000	78
	618	6030		CONDT (PVC) (SCH 40) (3") (BORE) DOLLARS and CENTS	LF	8,214.000	79
	618	6046		CONDT (PVC) (SCH 80) (2") DOLLARS and CENTS	LF	404.000	80
	618	6047		CONDT (PVC) (SCH 80) (2") (BORE) DOLLARS and CENTS	LF	640.000	81
	618	6066		CONDT (RM) (1 1/4") DOLLARS and CENTS	LF	6,460.000	82
	618	6070		CONDT (RM) (2") DOLLARS and CENTS	LF	6,530.000	83
	618	6074		CONDT (RM) (3") DOLLARS and CENTS	LF	504.000	84

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	620	6005		ELEC CONDR (NO.10) BARE DOLLARS and CENTS	LF	3,810.000	85
	620	6006		ELEC CONDR (NO.10) INSULATED DOLLARS and CENTS	LF	7,780.000	86
	620	6007		ELEC CONDR (NO.8) BARE DOLLARS and CENTS	LF	2,290.000	87
	620	6008		ELEC CONDR (NO.8) INSULATED DOLLARS and CENTS	LF	35,213.000	88
	620	6009		ELEC CONDR (NO.6) BARE DOLLARS and CENTS	LF	33,068.000	89
	620	6010		ELEC CONDR (NO.6) INSULATED DOLLARS and CENTS	LF	79,687.000	90
	620	6011		ELEC CONDR (NO.4) BARE DOLLARS and CENTS	LF	20,780.000	91
	620	6012		ELEC CONDR (NO.4) INSULATED DOLLARS and CENTS	LF	64,520.000	92
	620	6015		ELEC CONDR (NO.2) BARE DOLLARS and CENTS	LF	16,285.000	93
	620	6016		ELEC CONDR (NO.2) INSULATED DOLLARS and CENTS	LF	43,746.000	94
	620	6017		ELEC CONDR (NO.1) BARE DOLLARS and CENTS	LF	7,950.000	95
	620	6018		ELEC CONDR (NO.1) INSULATED DOLLARS and CENTS	LF	21,200.000	96

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	620	6019		ELEC CONDR (NO.1/0) BARE DOLLARS and CENTS	LF	4,880.000	97
	620	6020		ELEC CONDR (NO.1/0) INSULATED DOLLARS and CENTS	LF	23,285.000	98
	624	6001		GROUND BOX TY A (122311) DOLLARS and CENTS	EA	54.000	99
	624	6002		GROUND BOX TY A (122311)W/APRON DOLLARS and CENTS	EA	122.000	100
	624	6010		GROUND BOX TY D (162922)W/APRON DOLLARS and CENTS	EA	62.000	101
	624	6028		REMOVE GROUND BOX DOLLARS and CENTS	EA	2.000	102
	628	6002		REMOVE ELECTRICAL SERVICES DOLLARS and CENTS	EA	16.000	103
	628	6040		ELC SRV TY A 240/480 060(NS)SS(E)EX(O) DOLLARS and CENTS	EA	1.000	104
	628	6042		ELC SRV TY A 240/480 060(NS)SS(E)GC(U) DOLLARS and CENTS	EA	7.000	105
	628	6073		ELC SRV TY A 240/480 100(NS)SS(E)GC(O) DOLLARS and CENTS	EA	2.000	106
	628	6074		ELC SRV TY A 240/480 100(NS)SS(E)GC(U) DOLLARS and CENTS	EA	1.000	107
	628	6153		ELC SRV TY D 120/240 060(NS)SS(N)TP(O) DOLLARS and CENTS	EA	1.000	108

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	628	6249		ELC SRV TY D 120/240 100(NS)SS(N)PS(U) DOLLARS and CENTS	EA	10.000	109
	628	6342		ELEC SRV TY D 120/240 125(NS)SS(N)PS(U) DOLLARS and CENTS	EA	2.000	110
	628	6346		ELC SRV TY D 120/240 100(NS)SS(N)EX(U) DOLLARS and CENTS	EA	5.000	111
	628	6347		ELC SRV TY D 120/240 150(NS)SS(N)EX(U) DOLLARS and CENTS	EA	1.000	112
	628	6351		ELEC SRV TY D 120/240 125(NS)SS(N)EX(O) DOLLARS and CENTS	EA	1.000	113
	628	6353		ELEC SRV TY D 120/240 150(NS)SS(N)PS(U) DOLLARS and CENTS	EA	1.000	114
	636	6001	001	ALUMINUM SIGNS (TY A) DOLLARS and CENTS	SF	105.000	115
	636	6003	001	ALUMINUM SIGNS (TY O) DOLLARS and CENTS	SF	5,546.500	116
	636	6006	001	REFURBISH ALUMINUM SIGNS (TY O) DOLLARS and CENTS	EA	3.000	117
	636	6009	001	REPLACE EXISTING ALUMINUM SIGNS(TY O) DOLLARS and CENTS	SF	143.750	118
	644	6066		IN SM RD SN SUP&AM (RAIL MOUNT) DOLLARS and CENTS	EA	57.000	119
	647	6003		REMOVE LRSA DOLLARS and CENTS	EA	3.000	120

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	650	6018		INS OH SN SUP(20 FT CANT) DOLLARS and CENTS	EA	1.000	121
	650	6020		INS OH SN SUP(20 FT CANT)(SPAN ONLY) DOLLARS and CENTS	EA	6.000	122
	650	6025		INS OH SN SUP(25 FT CANT) DOLLARS and CENTS	EA	2.000	123
	650	6027		INS OH SN SUP(25 FT CANT)(SPAN ONLY) DOLLARS and CENTS	EA	31.000	124
	650	6032		INS OH SN SUP(30 FT CANT) DOLLARS and CENTS	EA	1.000	125
	650	6041		INS OH SN SUP(35 FT CANT)(SPAN ONLY) DOLLARS and CENTS	EA	1.000	126
	650	6045		INS OH SN SUP(40 FT CANT) DOLLARS and CENTS	EA	1.000	127
	650	6204		REMOVE OVERHD SIGN SUP DOLLARS and CENTS	EA	15.000	128
	650	6205		REMOVE OVERHD SIGN SUP (SIGN ONLY) DOLLARS and CENTS	EA	2.000	129
	658	6015		INSTL DEL ASSM (D-SW)SZ (BRF)GF1 DOLLARS and CENTS	EA	152.000	130
	658	6027		INSTL DEL ASSM (D-SY)SZ (BRF)CTB (BI) DOLLARS and CENTS	EA	600.000	131
	658	6028		INSTL DEL ASSM (D-SY)SZ (BRF)GF1 DOLLARS and CENTS	EA	44.000	132

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	662	6061		WK ZN PAV MRK REMOV (W)4"(DOT) DOLLARS and CENTS	LF	1,000.000	133
	662	6063		WK ZN PAV MRK REMOV (W)4"(SLD) DOLLARS and CENTS	LF	41,980.000	134
	662	6064		WK ZN PAV MRK REMOV (W)6"(BRK) DOLLARS and CENTS	LF	1,769.000	135
	662	6065		WK ZN PAV MRK REMOV (W)6"(DOT) DOLLARS and CENTS	LF	44,618.000	136
	662	6067		WK ZN PAV MRK REMOV (W)6"(SLD) DOLLARS and CENTS	LF	2,158.000	137
	662	6072		WK ZN PAV MRK REMOV (W)12"(LNDP) DOLLARS and CENTS	LF	356.000	138
	662	6073		WK ZN PAV MRK REMOV (W)12"(SLD) DOLLARS and CENTS	LF	2,544.000	139
	662	6088		WK ZN PAV MRK REMOV (W)(TPL ARROW) DOLLARS and CENTS	EA	6.000	140
	662	6095		WK ZN PAV MRK REMOV (Y)4"(SLD) DOLLARS and CENTS	LF	98,745.000	141
	662	6098		WK ZN PAV MRK REMOV (Y)6"(SLD) DOLLARS and CENTS	LF	75,180.000	142
	672	6010		REFL PAV MRKR TY II-C-R DOLLARS and CENTS	EA	22,790.000	143
	677	6001		ELIM EXT PAV MRK & MRKS (4") DOLLARS and CENTS	LF	148,286.000	144

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	677	6002		ELIM EXT PAV MRK & MRKS (6") DOLLARS and CENTS	LF	565,592.000	145
	677	6003		ELIM EXT PAV MRK & MRKS (8") DOLLARS and CENTS	LF	52,988.000	146
	677	6005		ELIM EXT PAV MRK & MRKS (12") DOLLARS and CENTS	LF	20,144.000	147
	677	6008		ELIM EXT PAV MRK & MRKS (ARROW) DOLLARS and CENTS	EA	8.000	148
	677	6012		ELIM EXT PAV MRK & MRKS (WORD) DOLLARS and CENTS	EA	312.000	149
	677	6017		ELIM EXT PAV MRK & MRKS (SYMBOL) DOLLARS and CENTS	EA	147.000	150
	678	6002		PAV SURF PREP FOR MRK (6") DOLLARS and CENTS	LF	548,914.000	151
	678	6004		PAV SURF PREP FOR MRK (8") DOLLARS and CENTS	LF	53,056.000	152
	678	6006		PAV SURF PREP FOR MRK (12") DOLLARS and CENTS	LF	37,651.000	153
	678	6009		PAV SURF PREP FOR MRK (ARROW) DOLLARS and CENTS	EA	15.000	154
	678	6016		PAV SURF PREP FOR MRK (WORD) DOLLARS and CENTS	EA	180.000	155
	678	6033		PAV SURF PREP FOR MRK (RPM) DOLLARS and CENTS	EA	22,790.000	156

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	730	6107		FULL - WIDTH MOWING DOLLARS and CENTS	CYC	8.000	157
	734	6002		LITTER REMOVAL DOLLARS and CENTS	CYC	8.000	158
	735	6001		DEBRIS REMOVAL (CNTR MEDIANS/ MAINLANES) DOLLARS and CENTS	CYC	8.000	159
	735	6005		DEBRIS REMOVAL (ENTRANCE/EXIT RAMPS) DOLLARS and CENTS	CYC	8.000	160
	738	6001		CLEANING / SWEEPING (CENTER MEDIAN) DOLLARS and CENTS	CYC	8.000	161
	738	6003		CLEANING / SWEEPING (OUTSIDE MAIN LANE) DOLLARS and CENTS	CYC	8.000	162
	738	6007		CLEANING / SWEEPING(ENTRANCE/EXIT RAMP) DOLLARS and CENTS	CYC	8.000	163
	764	6001		DRAIN INLET CLEANING DOLLARS and CENTS	EA	434.000	164
	764	6021		SLOTTED DRAIN CLEANING DOLLARS and CENTS	LF	6,503.000	165
	6000	6002		REMOVE ABOVE-GROUND CONDUIT DOLLARS and CENTS	LF	5,290.000	166
	6000	6005		REMOVE UNDERGROUND CONDUIT DOLLARS and CENTS	LF	2,570.000	167

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	6000	6008		REMOVE CONDUCTOR DOLLARS and CENTS	LF	33,000.000	168
	6000	6098		INSTALL CIRCUIT BREAKER DOLLARS and CENTS	EA	5.000	169
	6001	6002		PORTABLE CHANGEABLE MESSAGE SIGN DOLLARS and CENTS	EA	6.000	170
	6007	6010		FIBER OPTIC CBL (SNGLE-MODE)(6 FIBER) DOLLARS and CENTS	LF	55,119.000	171
	6007	6011		FIBER OPTIC CBL (SNGLE-MODE)(12 FIBER) DOLLARS and CENTS	LF	570.000	172
	6007	6012		FIBER OPTIC CBL (SNGLE-MODE)(24 FIBER) DOLLARS and CENTS	LF	12,745.000	173
	6007	6013		FIBER OPTIC CBL (SNGLE-MODE)(36 FIBER) DOLLARS and CENTS	LF	15,856.000	174
	6007	6014		FIBER OPTIC CBL (SNGLE-MODE)(48 FIBER) DOLLARS and CENTS	LF	14,816.000	175
	6007	6015		FIBER OPTIC CBL (SNGLE-MODE)(72 FIBER) DOLLARS and CENTS	LF	78,934.000	176
	6007	6087		FO SPLICE ENCLOSURE (TYPE 1) DOLLARS and CENTS	EA	1.000	177
	6007	6094		FIBER OPTIC FUSION SPLICE DOLLARS and CENTS	EA	72.000	178
	6007	6095		FIBER OPTIC PATCH PANEL (6 POSITION) DOLLARS and CENTS	EA	44.000	179

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	6007	6096		FIBER OPTIC PATCH PANEL (12 POSITION) DOLLARS and CENTS	EA	5.000	180
	6007	6100		FIBER OPTIC PATCH PANEL (72 POSITION) DOLLARS and CENTS	EA	9.000	181
	6007	6101		FIBER OPTIC PATCH PANEL (96 POSITION) DOLLARS and CENTS	EA	1.000	182
	6008	6027		ITS GRND MNT CAB (TY 4) (CONF 2) DOLLARS and CENTS	EA	6.000	183
	6010	6002	001	CCTV FIELD EQUIPMENT (DIGITAL) DOLLARS and CENTS	EA	26.000	184
	6010	6004	001	CCTV MOUNT (POLE) DOLLARS and CENTS	EA	26.000	185
	6016	6006		ITS MULTI-DUCT CND (PVC-40) DOLLARS and CENTS	LF	7,555.000	186
	6016	6007		ITS MULTI-DUCT CND (PVC-40)(BORE) DOLLARS and CENTS	LF	3,735.000	187
	6016	6013		ITS MULTI-DUCT CND (RMC) DOLLARS and CENTS	LF	252.000	188
	6020	6004		MLTPLY PV MK W/WTY (W) (6") (SLD) DOLLARS and CENTS	LF	169,318.000	189
	6020	6005		MLTPLY PV MK W/WTY (W) (6") (BRK) DOLLARS and CENTS	LF	210,137.000	190
	6020	6006		MLTPLY PV MK W/WTY (W) (6") (DOT) DOLLARS and CENTS	LF	3,101.000	191

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	6020	6007		MLTPLY PV MK W/WTY (W) (8") (SLD) DOLLARS and CENTS	LF	53,056.000	192
	6020	6008		MLTPLY PV MK W/WTY (W) (12") (SLD) DOLLARS and CENTS	LF	23,546.000	193
	6020	6009		MLTPLY PV MK W/WTY (W) (12") (LNDP) DOLLARS and CENTS	LF	14,105.000	194
	6020	6014		MLTPLY PV MK W/WTY (Y) (6") (SLD) DOLLARS and CENTS	LF	169,329.000	195
	6020	6023		MLTPLY PV MK (W) (ARROW) DOLLARS and CENTS	EA	17.000	196
	6020	6027		MLTPLY PV MK (W) (WORD) DOLLARS and CENTS	EA	180.000	197
	6027	6003		CONDUIT (PREPARE) DOLLARS and CENTS	LF	62,040.000	198
	6027	6004		JUNCTION BOX (INSTALL) DOLLARS and CENTS	EA	21.000	199
	6027	6008		GROUND BOX (PREPARE) DOLLARS and CENTS	EA	126.000	200
	6032	6001		SYSTEM INTEGRATION DOLLARS and CENTS	LS	1.000	201
	6049	6003		LONG CHANNEL MOUNT CURB SYS (REMOVE) DOLLARS and CENTS	LF	73,850.000	202
	6053	6001		SHIFT OVERHEAD SIGN PANELS DOLLARS and CENTS	EA	1.000	203

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	6058	6001		BBU SYSTEM (EXTERNAL BATT CABINET) DOLLARS and CENTS	EA	5.000	204
	6064	6010	001	ITS POLE (30 FT)(90 MPH) DOLLARS and CENTS	EA	12.000	205
	6064	6046	001	ITS POLE (55 FT)(90 MPH) DOLLARS and CENTS	EA	1.000	206
	6064	6084	001	ITS POLE MNT CAB (TY 2)(CONF 2) DOLLARS and CENTS	EA	13.000	207
	6185	6002	002	TMA (STATIONARY) DOLLARS and CENTS	DAY	1,200.000	208
	6185	6005	002	TMA (MOBILE OPERATION) DOLLARS and CENTS	DAY	300.000	209
	6186	6004		ITS GND BOX(PCAST) TY 1 (243648)W/APRN DOLLARS and CENTS	EA	20.000	210
	6186	6006		ITS GND BOX(PCAST) TY 1 (243660)W/APRN DOLLARS and CENTS	EA	26.000	211
	6186	6012		ITS GND BOX(PCAST) TY 2 (366060)W/APRN DOLLARS and CENTS	EA	13.000	212
	6186	6025		REMOVE ITS GROUND BOX DOLLARS and CENTS	EA	1.000	213
	6277	6001		INST LRG GRND MNT AND OVRHD SIGN(STATE) DOLLARS and CENTS	SF	114.000	214
	6304	6002		ITS RVSD (DATA COLLECT & WWA) SYS DOLLARS and CENTS	EA	5.000	215

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	6405	6001		GROUND BOX (173030) DOLLARS and CENTS	EA	12.000	216
	6405	6002		GROUND BOX (111824) DOLLARS and CENTS	EA	6.000	217
	6406	6001		LIGHTING PROTECTION SYSTEM DOLLARS and CENTS	EA	5.000	218
	6407	6001	001	VARIABLE MESSAGE SYS(VMS) W/FND MTD CAB DOLLARS and CENTS	EA	15.000	219
	6407	6002	001	VARIABLE MESSAGE SYS(VMS) W/OUT CABINET DOLLARS and CENTS	EA	1.000	220
	6475	6001		HARDENED ETHERNET SWITCH DOLLARS and CENTS	EA	10.000	221
	6503	6001		AMBER SLDMS 7X50 W/FTD MTD CAB DOLLARS and CENTS	EA	4.000	222
	6503	6002		AMBER SLDMS 7X35 W/FTD MTD CAB DOLLARS and CENTS	EA	1.000	223
	6503	6003		AMBER SLDMS 7X35 W/OUT CABINET DOLLARS and CENTS	EA	1.000	224

CERTIFICATION OF INTEREST IN OTHER BID PROPOSALS FOR THIS WORK

By signing this proposal, the bidding firm and the signer certify that the following information, as indicated by checking “Yes” or “No” below, is true, accurate, and complete.

A. Quotation(s) have been issued in this firm's name to other firm(s) interested in this work for consideration for performing a portion of this work.

_____ YES

_____ NO

B. If this proposal is the low bid, the bidder agrees to provide the following information prior to award of the contract.

1. Identify firms which bid as a prime contractor and from which the bidder received quotations for work on this project.
2. Identify all the firms which bid as a prime contractor to which the bidder gave quotations for work on this project.

DISCLOSURE OF LOBBYING ACTIVITIES

Complete this form to disclose lobbying activities pursuant to 31 U.S.C. 1352 (See reverse for public burden disclosure.)

1. Type of Federal Action: a. contract b. grant c. cooperative agreement d. loan e. loan guarantee f. loan insurance	2. Status of Federal Action: a. bid/offer/application b. initial award c. post-award	3. Report Type: a. initial filing b. grant For material change only: year _____ quarter _____ date of last report _____

4. **Name and Address of Reporting Entity:** ? Prime ? Subawardee Tier _____, if known: **Congressional District**, if known:	5. **If Reporting Entity in No. 4 is Subawardee,** Enter Name and Address of Prime: **Congressional District**, if known:
6. **Federal Department/Agency:**	7. **Federal Program Name/Description:** CFDA Number, if applicable: _____
8. **Federal Action Number**, if known:	9. **Award Amount,** if known: $ _____
10. a. Name and Address of Lobbying Entity (if individual, last name, first name, MI):	b. Individuals Performing Services (including address if different from No. 10a) (last name, first name, MI):

(attach Continuation Sheet(s) SF-LLL-A, if necessary)

11. Amount of Payment (check all that apply): $ _____ actual planned 12. Form of Payment (check all that apply) a. cash b. in-kind; specify: nature _____ value _____	13. Type of Payment (check all that apply): a. retainer b. one-time fee c. commission d. contingent fee e. deferred f. other; specify: _____

14. Brief Description of Services Performed or to be Performed and Date(s) of Service, including officer(s), employee(s), or Member(s) contacted, for Payment Indicated in Item 11:

(attach Continuation Sheet(s) SF-LLL-A, if necessary)

15. **Continuation Sheet(s) SF-LLL-A attached:** ? Yes ? No

16. Information requested through this form is authorized by title 31 U.S.C. section 1352. This disclosure of lobbying activities is a material representation of fact upon which reliance was placed by the tier above when this transaction was made or entered into. This disclosure is required pursuant to 31 U.S.C. 1352. This information will be reported to the Congress semi-annually and will be available for public inspection. Any person who fails to file the required disclosure shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.	Signature: _____ Print Name: _____ Title: _____ Telephone No: _____ Date: _____

FEDERAL USE ONLY	Authorized for Local Reproduction Standard Form - LLL

INSTRUCTIONS FOR COMPLETION OF SF-LLL, DISCLOSURE OF LOBBYING ACTIVITIES

This disclosure form shall be completed by the reporting entity, whether subawardee or prime Federal recipient, at the initiation or receipt of a covered Federal action, or a material change to a previous filing, pursuant to title 31 U.S.C section 1352. The filing of a form is required for each payment or agreement to make payment to any lobbying entity for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with a covered Federal action. Use the SF-LLL-A Continuation Sheet for additional information if the space on the form is inadequate. Complete all items that apply for both the initial filing and material change report. Refer to the implementing guidance published by the Office of Management and Budget for additional information.

1. Identify the type of covered Federal action for which lobbying activity is and/or has been secured to influence the outcome of a covered Federal action.
2. Identify the status of the covered Federal action.
3. Identify the appropriate classification of this report. If this is a follow-up report caused by a material change to the information previously reported, enter the year and quarter in which the change occurred. Enter the date of the last previously submitted report by this reporting entity or this covered Federal action.
4. Enter the full name, address, city, state and zip code of the reporting entity. Include Congressional District, if known. Check the appropriate classification of the reporting entity that designates if it is, or expects to be, a prime or subaward recipient. Identify the tier of the subawardee, e.g., the first subawardee of the prime is the 1st tier. Subawards include but are not limited to subcontracts, subgrants and contract awards under grants.
5. If the organization filing the report in item 4 checks "Subawardee", then enter the full name, address, city, state and zip code of the prime Federal recipient. Include Congressional District, if known.
6. Enter the name of the Federal agency making the award or loan commitment. Include at least one organizational level below agency name, if known. For example, Department of Transportation, United States Coast Guard.
7. Enter the Federal program name or description for the covered Federal action (item 1). If known, enter the full Catalog of Federal Domestic Assistance (CFDA) number for grants, cooperative agreements, loans, and loan commitments.
8. Enter the most appropriate Federal identifying number available for the Federal action identified in item 1 (e.g., Request for Proposal (RFP) number; Invitation for Bid (IFB) number; grant announcement number, the contract, grant, or loan award number; the application/proposal control number assigned by the Federal agency). Include prefixes, e.g., "RFP-DE-90-001."
9. For a covered Federal action where there has been an award or loan commitment by the Federal agency, enter the Federal amount of the award/loan commitment for the prime entity identified in item 4 or 5.
10. (a) Enter the full name, address, city, state and zip code of the lobbying entity engaged by the reporting entity identified in item 4 to influence the covered Federal action.
    (b) Enter the full names of the individual(s) performing services, and include full address if different from 10(a). Enter Last Name, First Name, and Middle Initial (MI).
11. Enter the amount of compensation paid or reasonably expected to be paid by the reporting entity (item 4) to the lobbying entity (item 10). Indicate whether the payment has been made (actual) or will be made (planned). Check all boxes that apply. If this is a material change report, enter the cumulative amount of payment made or planned to be made.
12. Check the appropriate box(es). Check all boxes that apply. If payment is made through an in-kind contribution, specify the nature and value of the in-kind payment.
13. Check the appropriate box(es). Check all boxes that apply. If other, specify nature.
14. Provide a specific and detailed description of the services that the lobbyist has performed, or will be expected to perform, and the date(s) of any services rendered. Include all preparatory and related activity, not just time spent in actual contact with Federal officials. Identify the Federal official(s) or employee(s) contacted or the officer(s), employee(s), or Member(s) of Congress that were contacted.
15. Check whether or not a SF-LLL-A Continuation Sheet(s) is attached.
16. The certifying official shall sign and date the form, print his/her name, title, and telephone number.

DISCLOSURE OF LOBBYING ACTIVITIES

Approved by OMB

0348-0046

CONTINUATION SHEET

Reporting Entity: _____ Page _____ of _____

CONTRACTOR'S ASSURANCE

(Subcontracts-Federal Aid Projects)

By signing this proposal, the contractor is giving assurances that all subcontract agreements will incorporate the Standard Specification and Special Provisions to Section 9.9., Payment Provisions for Subcontractors, all subcontract agreements exceeding $2,000 will incorporate the applicable Wage Determination Decision, and all subcontract agreements will incorporate the following:

Special Provision	Certification of Nondiscrimination in Employment
Special Provision	Notice of Requirement for Affirmative Action to Ensure Equal Employment Opportunity (Executive Order 11246)
Special Provision	Standard Federal Equal Employment Opportunity
Construction	Construction Specifications (Executive Order 11246)
Form FHWA 1273	Required Contract Provisions Federal-aid Construction Contracts (Form FHWA 1273 must also be physically attached to subcontracts and all lower-tier subcontracts)
Special Provision	Nondiscrimination (Include provisions of Sections 3.1 – 3.6 in all subcontracts and agreements for materials)
Special Provision	Cargo Preference Act Requirements in Federal-Aid Contracts
Special Provision	Disadvantaged Business Enterprise in Federal-Aid Contracts

ENGINEER SEAL

Control **0047-06-158, ETC.**

Project **STP 2024(041)MM**

Highway **US 75**

County **COLLIN, ETC.**

The enclosed Texas Department of Transportation Specifications, Special Specifications, Special Provisions, General Notes and Specification Data in this document have been selected by me, or under my responsible supervision as being applicable to this project. Alteration of a sealed document without proper notification to the responsible engineer is an offense under the Texas Engineering Practice Act.

The seal appearing on this document was authorized by

Yuan Ruo Wang, P.E.

JUNE 07, 2023

SPECIFICATION DATA

Table 1: Soil Constants Requirements				
Item	Description	Plasticity Index		Note
		Max	Min	
132	Embk(DC) (Type C1)	40	8	1
132	Embk(DC) (Type C2)	25	8	2

Note 1: Material excavated from the project must meet the PI requirements when used in the top 10 feet of embankment that supports the pavement structure or other locations shown in the plans. Do not use shale and obtain approval to incorporate shaley clay produced by the construction project.

Note 2: Use as a non-select embankment backfill as defined under Item 423.2.4.1. Use as an embankment to backfill behind abutments to the extent of the approach slab or to backfill areas enclosed by an abutment and other locations as shown in the plans.

Table 1: Basis of Estimate for Permanent Construction					
Item	Description	Thickness	Rate		Quantity
161	Compost Manufactured Topsoil (4”)	N/A	See Specifications		6583 SY
162	Block Sod	N/A	See Specifications		6583 SY
166 *	Fertilizer (12-6-6)	N/A	500	Lbs./Ac	0.35 Ton
168	Vegetative Watering (Warm)**	N/A	12	MG/Ac/Day	1517 MG
*For contractor’s information only **Use Summer rate for calculation, adjust for actual field conditions/temperatures as necessary. See Vegetation Establishment Plan Sheet for estimated daily rates. ***Portland Concrete Cement					
Note: (1) Base material weight based on 1.50 Ton/CY (dry- compacted) (2) Asphalt weight based on 110 Lbs./SY/In					

Table 3: Basis of Estimate for Temporary Erosion Control Items				
Item	Description	Rate		Quantity
164	Drill Seeding (Temp) (Warm or Cool)	See Specifications		6333 SY
166*	Fertilizer (12-6-6)	500	Lb/Ac	0.35 Ton
168	Vegetative Watering (Warm)**	12	MG/Ac/Day	423 MG

*For Contractor's Information Only.
**Use Summer rate for calculation, adjust for Actual Field Conditions/Temperatures as Necessary. See Vegetation Establishment Sheet for estimated daily rates.

Table 2: Basis of Estimate for Finish Colors (Items 427) [1]		
Element	Color	Specification Number [2]
CTB, SSCB	Maple Sugar (5a)	33617
Columns	Maple Sugar (5a)	33617
Deflection Walls	Maple Sugar (5a)	33617

1. Unless otherwise noted, it is the intent of these plans that all exposed surfaces (concrete or steel) of bridges, retaining walls, concrete traffic railing and concrete traffic barrier be given a tinted coating as shown or as directed. Such coating shall meet the applicable provisions of Item 427 or Item 446.

2. Federal Standard 595 colors.

GENERAL

The construction, operation and maintenance of the proposed project will be consistent with the state implementation plan as prepared by the Texas Commission on Environmental Quality.

The disturbed area for this project, as shown on the plans is 5.3 acres. However, the Total Disturbed Area (TDA) will establish the required authorization for storm water discharges. The TDA of this project will be determined by the sum of the disturbed area in all project locations in the contract, and all disturbed area on all Project-Specific Locations (PSL) located in the project limits and/or within 1 mile of the project limits. The department will obtain an authorization to discharge storm water from the Texas Commission on Environmental Quality (TCEQ) for the construction site as shown on the plans, according to the TDA of the project. The contractor will obtain any required authorization from the TCEQ for the discharge of storm water from any PSL for construction support activities on or off of the project row according to the TDA of the project. When the TDA for the project exceeds 1 acre, provide a copy of the appropriate application of permit (NOI, or Construction Site Notice) to the engineer, for any PSL located in the project limits or within 1 mile of the project limits. Follow the directives and adhere to all requirements set forth in the TCEQ, Texas Pollution Discharge Elimination System, Construction General Permit (TPDES, CGP).

County: Collin

Highway: US 75

This project required permitting with environmental resources agencies as outlined in the plan set Environmental Permits, Issues, and Commitments (EPIC) Sheet. There is a high probability that an environmentally sensitive area could be encountered on the contractor designated Project-Specific Locations (PSL) for this project (haul roads, equipment staging areas, borrow pits, disposal sites, field offices, storage areas, parking areas, etc.). Item 7.6 "Project-Specific Locations", provides a listing of regulatory agencies that may need to be contacted regarding this project.

Provide the Engineer with a copy of all DBE subcontractor agreements prior to commencing work.

Leave all right of way areas undisturbed until actual construction is to be performed in said areas.

Questions may be submitted via the Letting Pre-Bid Q&A web page. This webpage can be accessed from the Notice to Contractors dashboard located at the following Address: https://tableau.txdot.gov/views/ProjectInformationDashboard/NoticetoContractors

or Contractor questions on this project are to be addressed to the following individual(s):

Jennifer Vorster Jennifer.Vorster@txdot.gov
Gerald Waltman Gerald.Waltman@txdot.gov

Contractor questions will be accepted through email, phone, and in person by the above individuals.

All contractor questions will be reviewed by the Engineer. All questions and any corresponding responses that are generated will be posted through the same Letting Pre-Bid Q&A web page.

The Letting Pre-Bid Q&A web page for each project can be accessed by using the dashboard to navigate to the project you are interested in by scrolling or filtering the dashboard using the controls on the left. Hover over the blue hyperlink for the project you want to view the Q&A for and click on the link in the window that pops up.

Provide as-built cable interconnection diagrams and communication network schematics at least 30 days prior to the start of data communications testing.

All materials and services not expressly called for in the specification or not shown in the plans, which may be necessary for complete and proper construction of the "ITS" Network, will be performed, furnished and installed at no cost to the Departmnet.

The Contractor shall ensure that the existing Dallas District ITS remains operational throughout the construction duration with a minimal lapse (48 hours maximum per outage for ITS) in video or data transmission unless otherwise approved by the Engineer

To minimize "down time" to the Dallas District ITS System, the relocation of power conductors shall be performed during a single weekend (9:00 pm Friday through 5:00 am Monday).

Contact the TxDOT Freeway Management Office (214-320-6602) at least 48 hours in advance of performing any work on this project that disconnects or reconnects existing TxDOT "ITS" fiber optic cable. TxDOT "ITS" personnel must be on-site while this work is performed.

The Contractor shall coordinate with LBJ Infrastructure Group at least one week in advance of any closures of the US 75 NB and SB HOV lane flyover to IH-635.

The following standard detail sheets have been modified*:*
C-RAIL-R(MOD)

Technology Zone General Notes

Contractor and Technology Systems Integrator Coordination
Coordinate with the Engineer and the Department's Systems Integrator prior to and during the installation of associated technology conduit and conduit stub-ups. Notify the Engineer in writing when all work within all the technology zones are estimated to be 30 days from completion. Such technology zone work includes (but is not limited to) the following:

A. Construction of the structure foundations in accordance with the plans.
B. Construction of conduit and ground boxes for future electrical conductors and communications cable.
C. Installation of lightning protection system for the technology zone, including conduits and conductors, as shown on drawings and in accordance with Item 6406.

Item 5:
Underground utilities owned by the Texas Department of Transportation may be present within the Right-Of-Way on this project. For signal, illumination, surveillance, and communications & control maintained by TxDOT, call the TxDOT Traffic Signal Office (214-320-6682) for locates a minimum of 48 hours in advance of excavation. For irrigation systems, call TxDOT Landscape Office (214-320-6205) for locates a minimum of 48 hours in advance of excavation. If city or town owned irrigation facilities are present, call the appropriate department of the local city or town a minimum of 48 hours in advance of excavation. The Contractor is liable for all damages when utilities are damaged due to Contractor's negligence including, but not limited to, repair or replacement at the Contractor's expense.

For the project to be deemed complete, permanently stabilize all unpaved disturbed areas of the project with a vegetative cover at a minimum of 70% density for the control of erosion.

Place construction stakes/station markings at intervals of no more than 100 feet or as directed by the Engineer. Place stakes and markings so as not to interfere with normal construction operations.

Submit all shop drawings, working drawings, or other documents which require review sufficiently in advance of scheduled construction to allow no less than thirty (30) calendar days for review and response.

When a precast or cast-in-place concrete element is included in the plans, a precast concrete alternate may be submitted in accordance with "Standard Operating Procedure for Alternate

Precast Proposal Submission" found online at https://www.txdot.gov/inside-txdot/forms-publications/consultants-contractors/publications/bridge.html#design. Acceptance or denial of an alternate is at the sole discretion of the Engineer. Impacts to the project schedule and any additional costs resulting from the use of alternates are the sole responsibility of the Contractor.

Item 6:
To comply with the latest provisions of Build America, Buy America Act (BABA Act) of the Bipartisan Infrastructure Law, the contractor must submit a notarized original of the TxDOT Construction Material Buy America Certification Form for all items classified as construction materials. This form is not required for materials classified as a manufactured product.

Refer to the Buy America Material Classification Sheet for clarification on material categorization.

The Buy America Material Classification Sheet is located at the below link. https://www.txdot.gov/business/resources/materials/buy-america-material-classification-sheet.html for clarification on material categorization.

Item 7:
Repair or replace any structures and utilities that might have been damaged by negligence or a failure to have utility locates performed.

Perform all electrical work in accordance with the National Electrical Code and Texas Department of Transportation Specifications.

Consult with appropriate electric company representatives according to their respective area to coordinate electrical services installations.

Holiday restrictions – The Engineer may decide that no lane closures or construction operations shall be allowed during the restricted periods listed in the following holiday schedule. TxDOT has the right to lengthen, shorten, or otherwise modify these restricted periods as actual, or expected, traffic conditions may warrant. Working days will not be charged for these restricted periods. No additional compensation will be allowed for these closures (i.e., overhead, delays, stand-by, barricades or any other associated cost impacts).

- New Year's Eve and Day (5 am on December 31 thru 10:00 pm January 1)
- Easter Holiday weekend (5 am on Friday thru 10:00 pm Sunday)
- Memorial Day weekend (5 am on Friday thru 10:00pm Monday)
- Independence Day (5 am on July 3 thru 10:00 pm on July 5)
- Labor Day weekend (5 am on Friday thru 10:00 pm Monday)
- Thanksgiving Holiday (5 am on Wednesday thru 10:00 pm Sunday)
- Christmas Holiday (5 am on December 23 thru 10:00 pm December 26)

No significant traffic generator events identified.

Item 8:
This Project will be a Six-Day Workweek in accordance with Article 8.3.1.2.

Nighttime work is allowed in accordance with Article 8.3.3.

Meet weekly with the engineer to notify him or her of planned work for the upcoming week.

Provide the engineer with a daily work schedule of planned work.

A 90 day delay start is included in the project for contractor mobilization.

Critical Path Method (CPM) schedule in P6 format will be required for this project. Submit baseline schedule and obtain approval prior to beginning construction. The Estimate will be held if monthly schedule update is not submitted.

Per Special Provision 008-045, this contract includes Lane Closure Assessment Fees for lane closures that remain in place and impeding traffic on the mainlanes of US 75 after the specified closure time has elapsed. Lane closure times and Lane Closure Assessment Fees are addressed under Item 502.

The disincentive deductions will be in addition to the Schedule of Liquidated Damages (SP000-1243) for this project.

Table 8-1

Milestone No.	Type	Milestone Description	Milestone Duration	Daily Incentive /Disincentive Rate
1	Disincentive	Construction of the median barrier from 93+00 to 108+50, signs, removal of existing signs, and other incidental construction within and near these limits as noted in Phase 3 Step 2 of the Traffic Control Plan. Time charges for the Milestone shall begin on the first day of closure of either the southbound US 75 wishbone access to IH 635 Express Lanes or the IH 635 Express Lanes wishbone access to US 75 northbound mainlanes. The Milestone ends once the median barrier reconstruction and sign structure construction has been approved by the Engineer and the southbound US 75 wishbone access to IH 635 Express Lanes and the IH 635 Express Lanes wishbone access to US 75 northbound mainlanes are open to traffic.	18 Working Days	$10,000/working day. There is a cap of 100 max disincentive working days.

2	Incentive	This milestone is for early completion of the permanent illumination shown in the plans prior to the completion of the overall project. Milestone begins on day 1 of times charges to the project. The Milestone is achieved once all permanent proposed illumination facilities throughout the project are complete with construction and burning per the specifications less the maintenance periods. Incentive days will be calculated as the difference between the initial as bid total contract working days and milestone completion.	Initial as bid contract working days	$2000/working day incentive. There is a cap of 500 max working incentive days.
3	Disincentive	This Milestone is for failure to maintain existing, temporary or proposed illumination throughout the corridor. Discincentive begins after failure of contractor to remedy defect of illumination within 7 calendar days of notification of issue by Engineer. Milestone is enforced at each instance of notification by Engineer to contractor of failure to maintain illumination.	7 calendar days after notification.	$1000/ calendar day discentive.

Item 100:
Remove the existing roadway small signs, delineators and object markers as shown on the plans, or as directed, during construction within the right of way. Small sign, delineator and object marker removals are subsidiary to this Item.

The limits of preparing right of way will be measured from along the centerline of construction as shown on the project layout sheet.

Item 104:
Sawing of concrete is not paid for directly, but is considered subsidiary to this item.

Excavated shale is not an acceptable material for embankment.

Items 110 and 132:
Scarify and loosen the excavated areas, unpaved surface areas, except rock, to a depth of at least 8 inches and compact in accordance with the specifications.

Item 132:
Excavated material from the project site has not been determined to be suitable for embankment. The bidder assumes all risk for the use of excavated materials for embankment and is expected to meet all material requirements for embankment regardless of the source.
Perform Tex-106-E (Plasticity Index) by an approved laboratory on excavated soils from sources outside right of way when used in roadway embankment. Provide the test results at no expense to the department. The engineer will sample and test soils produced by the construction project for specification requirements or material sources specified in the plans.

Earth embankment Type C, is mainly composed of material other than shale. Furnish material that is free from vegetation or other objectionable material and that conforms to the requirements of Table 1 (Sheet A). If necessary, treat material with lime slurry in accordance with Item 260, "Lime Treatment (Road-Mixed)" in order to meet these requirements. Use Tex-121-E, figure 1, page 4 to calculate the amount of lime required. When lime treated subgrade is specified, 3000 PPM is the maximum allowed sulfate content in the top 3 feet when material comes from borrow source. Follow recommendations of 260.4.4 for mixing and mellowing. The engineer will test material placed or excavated to a depth of one foot below and laterally to one foot outside the proposed treatment limit. Lime treatment of this material will not be paid for directly, but will be considered subsidiary to this item.

Do not use shaley clays in embankment unless approved in writing.

Item 160:
Sequence construction operations to salvage topsoil from one location and spread on areas ready to receive topsoil. Keep stockpiling of topsoil to a minimum.

Use fertile clay or loam from the project site not more than six inches below natural grade as topsoil.

Item 161:
Provide tickets representing quantity of compost delivered to site.

Item 301:
Provide liquid antistripping agents unless otherwise directed. Add the minimum dosage determined by the manufacturer or higher dosage determined by design requirement and try subsequent trials at 0.25% increments.

Item 360:
Use of multiple piece tiebars will be required. Provide chairs for multiple piece tiebars, threaded connectors or other adequate devices, used in concrete paving, or tie them to the pavement reinforcing steel. If approved by the engineer for specific areas, in lieu of multiple piece tiebars, drill holes into the pavement and grout straight tiebars in place with epoxy. Use a non-impact, rotary core drill to prevent damage to the pavement unless otherwise directed. Clean the drill holes and then completely fill with epoxy before inserting the tiebar. Do not bend the tiebars or insert them into plastic concrete without the approval of the engineer.

If asphalt curing is used, cure the concrete pavement with MS-2.

Stockpile the concrete aggregates at the plant site.

Provide pavement widening joints, as detailed in the plans, at all locations where concrete pavement is placed adjacent to existing concrete pavement. Installation of these joints is not paid for directly, but is considered subsidiary to this item.

Payment for furnishing and installing the pre-molded expansion joint material between the retaining walls and concrete pavement is not paid for directly, but is considered subsidiary to this item.

Provide a curing machine equipped with rubber tires, or other acceptable arrangement, so that the machine will span the pavement and monolithic curb.

Place construction, sawed and contraction joints in accordance with the pavement detail sheet and as directed. Joint locations, other than as shown on the plans, are subject to approval.

If a traveling form paver is used, provide one equipped with an electronically operated horizontal control device.

Use "mechanical steel placing equipment" at the discretion of the engineer.

If more than 30% of an area in any 1000-Ft section of roadway requires grinding, action will be taken by the Contractor to make that 1000-Ft full width section uniform without changing ride quality, compromising quality of pavement and decreasing skid resistance. Approved blasting method or other method approved by the Engineer will be performed at the Contractor's expense.

Item 416:

Extend drilled shaft foundations for overhead sign structures minimum five feet into rock at locations where rock is encountered at a depth less than the drilled shaft lengths shown in the plans.

Provide a formed smooth finish for all portions of drill shafts extending above proposed ground. Include cost for this work in the unit bid price for this item.

Base all drilled shaft foundations for overhead sign structures on the lengths shown on the plans or as approved in writing. Make calculations for measurement of foundations in accordance with Article 9.1 of the standard specifications. Measure increase or decreases in the quantities required by change in design as specified and the revised quantities will be the basis for payment.

Use concrete classified as "miscellaneous concrete" for ground mounted sign foundations, with the exception of large roadside signs and overhead sign structures.

Do not install PVC and/or rigid metal conduit in sign foundations for sign structures without sign lights.

Payment will be made only once for drilling the shaft regardless of the extra work caused by obstructions.

County: Collin

Highway: US 75

Item 420:
Apply an ordinary surface finish to all concrete surfaces within 30 days after form removal.

Item 421:
Furnish mix designs to the Engineer in a format compatible to the latest version of the Department's Construction Management System (Site Manager). Mix Design templates will be provided by the Engineer.

Provide High Performance Concrete (HPC) of the class specified for all railing and permanent concrete traffic barrier placed on bridges or approach slabs. HPC concrete is not required for portions of rail or concrete traffic barrier not located on a bridge.

Provide sulfate resistant concrete for box culverts and all drilled shafts.

Strength evaluation using maturity testing, Tex-426-A, may be used for all concrete elements except drilled shafts and mass concrete pours.

Provide a digital hydraulic compression testing Machine and accessories. The machine shall have a minimum testing range of 2500 pounds force to 250,000 pounds force with a hydraulic switching valve to allow for rapid advancing, hold, controlled advancing and rapid retracting. The machine shall have a load cell to measure compressive forces within the testing range and shall be calibrated and verified in accordance with ASTM latest version. The Machine can meet or exceed the following when approved by the Engineer:

ELE International ACCU-TEK250 Digital Compression Tester including accessories or Forney F-250EX Standard Compression Machine including accessories or TxDOT approved equal. Supply the Engineer with a list of certified personnel and copies of their current ACI certificates before beginning production and when personnel changes are made. Supply hard copies of calibration reports for testing equipment when required by the Engineer.

Item 440:
Provide reinforcing steel with epoxy coating meeting the requirements of item 440 for the following bridge components: approach slab, slab, sidewalk, median, concrete traffic barrier, and rail.

Epoxy coated reinforcing is not required for portions of rail or concrete traffic barrier not located on a bridge.

All ties, chairs and other appurtenances used with epoxy coated reinforcing shall be epoxy coated or non-metallic.

Fiber Reinforced Concrete (FRC) can be used as a substitute for Non-Structural Class Reinforced Concrete in Mow-Strip and Rip Rap Items as approved. FRC may also be used for other Non-Structural Class Reinforced Concrete Items as approved.

Item 442:
Use temperature Zone 1 for CVN testing.

Item 449:
Use Thomas & Betts Kopr-Shield, MG Chemicals #846, MG Chemicals #8463, NYOGEL #756G, Pro-Shield #7308, Cho-Lube #4220, or other approved electrically conducting lubricant compound.

Item 500:
Material On Hand (MOH) will not be used in calculating partial payments for Mobilization.

Item 502:
The Contractor Force Account "Safety Contingency" that has been established for this project is intended to be utilized for work zone enhancements, to improve the effectiveness of the Traffic Control Plan, that could not be foreseen in the project planning and design stage. These enhancements will be mutually agreed upon by the Engineer and the Contractor's Responsible Person based on weekly or more frequent traffic management reviews on the project. The Engineer may choose to use existing bid items if it does not slow the implementation of enhancement.

Access will be provided to all business and residences at all times. Where turning radii are limited during phased construction at intersections, provide all weather surfaces such as RAP or base in turning movements to accommodate and to protect the traffic from edge drop-offs. Materials, labor, maintenance and removal for these temporary accesses and radii will not be paid for directly but will be considered subsidiary to the various bid items.

Provide written proposed lane closure information by 1:00 pm on the business day prior to the proposed closures. Do not close lanes when this requirement is not met.

Place barricades and signs in locations that do not obstruct the sight distance of drivers entering the highway from driveways or side streets.

When moving unlicensed equipment on or across any pavement or public highways, protect the pavement from all damage using an acceptable method.

As approved by the Engineer, provide uniformed off duty police officers and squad cars during lane or ramp closures, night time work or other situations that indicate a need for additional traffic control to protect the traveling public or the construction workforce. Provide documentation such as payroll, log sheets with signatures and badge number, or invoices from the government entity providing the officers for reimbursement. Complete the weekly tracking form provided by the department and submit invoices that agree with the tracking form for payment at the end of each month approved services were provided. Reimbursement will not be made for coordination fees charged by any party.

Patrol vehicles must be clearly marked to correspond with the officer's agency and equipped with appropriate lights to identify them as law enforcement. For patrol vehicles not owned by a law enforcement agency, markings will be retroreflective and legible from 100 ft. from both sides and the rear of the vehicle. Lights will be high intensity and visible from all angles.

The Contractor may begin closing lanes of the NBML/SBML of US 75 at 9:00 PM. The Contractor must have all NBML/SBML of US 75 open by 5:00 AM. Daytime closures are limited

to 1 Lane of the NBML/SBML of US 75 between 9:30 am to 3:30 pm, Monday through Friday. Full Freeway closures are not allowed unless otherwise approved in writing by the Engineer.

The lane closure disincentive fee is shown on the following table. The fee applies to the Contractor for closures that are outside the times specified above for each hour, regardless of the length of the lane closure or obstruction.

Main Lane Disincentive

*No. of ML's Closed	**Cost Deduction/Hr
1	$ 5,000.00
2	$ 10,000.00
3	$ 15,000.00
4	$ 20,000.00
5+	$ 25,000.00

*Main Lanes include all Thru lanes including HOV/Managed Lanes
**Deducted costs will be prorated by rounding up to the nearest 15-minute increment.

Traffic Control Plans with Lane Closures causing back-ups of 20 minutes or greater in duration will be modified by the Engineer up to and including removal of the lane closure.

Additional lanes may be closed, started earlier, or extended later with written permission of the Engineer.

tem 504:
Furnish one Field Office and Laboratory (Type B) for this project.

Chain link fencing (6-ft. chain-link fence, a top-mounted 3-strand barbed wire, and separate 16-ft. entrance and exit gates to facilitate pull through maneuvers of the vehicles), area dimensioned as directed by the Engineer, will be provided around TxDOT field office/laboratory and parking areas separate from contractor areas. Keep Contractor and TxDOT parking separate. No Contractor vehicles, equipment, dumpsters, storage, etc. is allowed in TxDOT parking area.

Allow for space to accommodate a minimum of 6 pull through parking spaces.

All field office layouts must be approved by the Engineer prior to installation.

The Engineer reserves the right to modify the layout.

A 10 lb. ABC fire extinguisher with up-to-date inspection tag, working smoke detector, first aid kit and an eye wash station shall be installed in all facilities used by TxDOT personnel. They shall be mounted on a wall that is easily accessible and not blocked by any permanent furniture.

Inspect the fire extinguishers, smoke detectors, eye wash stations and first aid kits every month. Make necessary corrections or updates as needed or as directed within 7 calendar days.

Provide a broadband internet connection with a minimum speed of 50 Mbps download and 50 Mbps upload, unless otherwise approved.

Provide an all in one color printer/scanner/copier that will print, scan and copy 11”x17” and 8.5”X11” sheets with software that is compatible with TxDOT equipment. This is subsidiary to the various bid items.

Item 506:

Take all practicable precautions to prevent debris from being discharged into the Waters of Texas or a designated wetland. Install Best Management Practices before demolition begins and maintain them during the demolition. Remove any debris or construction material that escapes containment devices and are discharged into the restricted areas, before the next rain event or within 24 hours of the discharge.

If temporary construction stream crossings are allowed under a Nationwide Permit, submit in writing for approval the type and location of each temporary stream crossing. Use temporary bridges, timber mats, or other structurally sound and non-eroding material for temporary stream crossings. A temporary culvert crossing will consist of storm sewer pipes and 4- to 8-inch nominal size rock. Temporary stream crossings must not cause more than minimal changes to the hydraulic flow characteristics of the stream, increase flooding, or cause more than minimal degradation of water quality. Remove the temporary stream crossings in their entirety and return the affected areas to their pre-existing elevation. All work and materials use for temporary construction stream crossings will not be paid for directly but are subsidiary to pertinent Items.

Provide SW3P Signs. Obtain from the Engineer a copy of the project’s completed TPDES Storm Water Program Construction Site Notice and Contractor Site Notice. Laminate the sheets and bond with adhesive to 36" X 36" plywood sign blanks. Ensure the sheets remain dry. Apply Type C Blue reflective sheeting as the background and add the text “SW3P” in 5" white lettering, centered at the top. Attach the signs to approved temporary mounts and locate at each of the project limits just inside the right of way line at a readable height or as directed by the Engineer. If the sign cannot be placed outside the clear zone, it must adhere to the TMUTCD. SW3P signs, maintenance, and reposting (for replacement or as needed to ensure readability) will be subsidiary to Item 502.

Concrete Washouts are required per the CGP. The Concrete Washout Area(s) structural controls must consist of temporary berms, temporary shallow pits, and/or temporary storage tanks to prevent contaminated runoff and must be lined as to prevent contamination of underlying soil. Ensure pits properly maintained including removal of concrete as not to allow over flow. The location(s) of washout area will be approved by the Engineer. When washout pits are no longer needed, they will be removed and area will be restored to original condition. This work, materials and labor will not be measured or paid for directly but will be subsidiary to Item 506, “Temporary Erosion, Sedimentation, and Environmental Controls.”

Item 508:
Testing of materials used in the construction of a temporary detour may be waived when approved by the Engineer.

Item 512:
The contractor will furnish pre-cast F Shape Barriers for traffic control, and remove and retain possession of non-permanent barriers at the end of the project. Pre-cast F Shape Barriers must have drainage slots as detailed on the Concrete Safety Barrier Standards. Submit for approval the type of barrier joint connection proposed for the project.

Item 514:
Provide High Performance Concrete (HPC) and epoxy coated reinforcing for all Permanent Concrete Traffic Barrier located on bridge approaches or bridge slabs.

Item 540:
Furnish one type of post throughout the project except as specifically noted in the plans.

Item 542:
Salvage metal beam guard fence removed from this project becomes the property of the contractor. The work involved in hauling this material will not be paid for directly, but will be considered subsidiary to this item.

Item 585:
Use Surface Test Type B pay adjustment schedule 2 on the travel lanes

Item 610:
Complete lighting in the initial stages of construction. Existing, temporary or proposed permanent illumination must be maintained at all times. Do not de-energize existing lighting before new lighting is operational without prior approval.

Use 480 volt electronic LED drivers for luminaires on this project.

Existing illumination circuits may be located within or adjacent to the project limits. Either verify with the Engineer or supply a video survey to the Engineer of all the lighting in and adjacent to the project limits before beginning work. Ensure that all assemblies operational at the beginning of construction are operational at the completion of the project. This work will be done at the contractor's expense.

New fusible disconnects shall be furnished by the Contractor and shall meet the requirements shown on standard RID (3).

Item 613:
Ground sleeves are required for all high mast poles.

Notify the District Transportation Operations Office immediately after new High Mast Poles have been erected.

Items 618, 6016 :

The location of conduits and ground boxes are diagrammatic only and may be shifted to accommodate field conditions as directed.

Secure permission and approval from the proper authority prior to cutting into or removing any sidewalks or curbs for installation of this Item. After the work is completed, the Contractor shall restore any curbs or walkways, which have been removed, to their original condition and to the satisfaction of the engineer.

Where a trench is cut through the surfaced parking shoulder, median or driveways for laying conduit, the base and surfacing will be replaced with similar materials equal in appearance and quality to the original construction.

Use a colored cleaner-primer on all PVC to PVC joints before application of PVC cement.

Seal all conduit ends with a permanently soft, non-toxic duct seal. Use a duct seal that does not adversely affect other plastic materials or corrode metals.

Place conduit under existing pavement by an approved boring method. Do not place boring pits closer than 2 feet from the edge of the pavement unless otherwise directed. Do not use water jetting. When conduits are bored, do not exceed 18 inches in the vertical and horizontal tolerances as measured from the intended target point.

Do not use a pneumatically driven device for punching holes beneath the pavement (commonly known as a "missile").
When holes are drilled through concrete structures, use a coring device. Do not use masonry or concrete drills.

Structurally mount junction boxes as shown on the plans.

Existing conduit may be proposed for reuse in this project. Conduit prep will be paid for under Item 6027 as directed by the Engineer.

Furnish and install a flat, high tensile strength polyester fiber pull tape in conduit runs in excess of 50 feet or for future use and protected with standard weather-tight conduit caps, as approved. Acceptable products include Garvin # PT-1250-3K, ComStar PUL 1250P3K, Ideal Part No. 31-315 or equal as approved by the Engineer. This work will not be paid for directly, but is subsidiary to this Item.

If the Contractor chooses to combine multiple conduits into one bore, the Contractor will install a casing around the conduits. The casing will not be paid for directly, but will be considered subsidiary to this item.

ITS" conduit shall be installed a minimum of 42 inches deep, when trenching methods are used, and a minimum of 60 inches deep when bored under existing pavement, unless shown otherwise in the plans.

When trenching through rocky soil, place “ITS” conduit on a two-inch sand cushion and backfill with a minimum of six inches of sand.

The minimum bending radius for all “ITS” conduits supplied on this project shall be 18 inches, or as approved.

Install a permanent non-metallic pull cord, with a minimum tensile strength of 600 pounds, in all new “ITS” conduits. For conduits installed for future use, plug conduits using a mechanical conduit plug. Ensure that the mechanical plug creates a water and airtight seal. This work will not be paid for directly but will be subsidiary to this item.

Install, for each “ITS” conduit run, a metallic underground warning tape, as detailed in the plans. This warning tape will be imprinted with “CAUTION BURIED FIBER OPTIC CABLE.” This will not be paid for directly, but will be considered subsidiary to Item 618: Conduit. The warning tape does not need to be installed when conduit is bored under a roadway section or landscaped area. At locations where the Contractor chooses to bore conduit underground, in areas where trenching methods can be used, the Contractor will install the metallic underground warning tape.

Item 620:

The equipment grounding conductor smaller than 4 AWG shall be a bare wire or identified with continuous green colored jacket insulation. Grounded conductors (Neutral) smaller than 4 AWG shall be identified by a continuous white colored jacket. Ungrounded conductors (Hot) in a 120/240v or 240/480v system shall be identified by each pole or leg. For 240-volt branch circuit fed from 120/240 source and 480-volt branch circuit fed from 240/480 source, ensure one leg is identified by a continuous black colored jacket and the other leg by a continuous red colored jacket.

Insulated tracer wire shall have Orange colored insulation and shall be labeled as a “Tracer Wire” in each Satellite Building, Hub Cabinet, and CCTV Cabinet with one exception: CCTV Cabinets located near Hub Cabinets. White phasing tape is not allowed to be used to signify a neutral on any conductor 6 AWG and smaller as per TxDOT specifications and the NEC.
For fiber duct banks with multi-duct conduits, tracer wire shall be installed in one innerduct.

Tracer wire is not to be tied or bonded to any other conductor or equipment.

All communication cables will be color-coded consistently, or permanently labeled, between all connections and splices, to ensure immediate identification. The Contractor will submit a chart or list identifying all cables, in a logical and sequential manner prior to installation, for the Engineer’s approval.

Item 624:

Slack conductors required by Standard Sheet ED(3)-14 will be subsidiary to Item 624.

Concrete removal required for installation of ground boxes will be subsidiary to Item 624.

See Item 6405 Ground Boxes for ground boxes located inside barrier deflection walls.

Item 628:

Contact the appropriate utility company during the first three weeks of the project lead-time period,obtain 911 address, verify service locations, and to allow adequate time for any necessary utility adjustments, transformer installation, etc.

The Meter Base or Transocket shall be mounted facing the roadway and the service enclosure shall be mounted on the opposite side of the service pole or pedestal.

Granite concrete service pole embedment depth shall be 10’ and shall be a minimum of 25’ above grade for overhead services.

Backfill Granite Concrete service poles with a Class A concrete in accordance with Item 421, "Hydraulic Cement Concrete", except consider the concrete subsidiary to Item 628 for payment purposes.

The Contractor shall obtain the street address of the new electrical service directly from the applicable City.

Label the service enclosures indicating service address as well as all required information as shown on the Electrical Detail (ED) standard sheets. Labeling shall be silk screening or other acceptable method. This work will not be paid for directly, but is subsidiary to this Item.

On the outside lower front of each electrical service meter base cover, install a 12 gauge minimum thickness stainless steel, aluminum or brass placard. The placard shall be engraved or stamped with the numeric portion of the street address and permanently affixed to the cover with exterior rated adhesive so as not to interfere with the operation of the latch. This work will not be paid for directly, but is subsidiary to this Item.

For existing services that are being upgraded to stainless steel service enclosures on existing supports, the Contractor shall provide a new enclosure with new components and all incidentals necessary to securely mount it to the support. If the proposed amperage loads of the upgraded services are higher than the existing loads, the Contractor shall coordinate with the utility company to ensure that their existing transformer and service conductors are of sufficient capacity.

A Licensed Master Electrician shall oversee the installation of all electrical services.

Bill the lighting electrical service power usage to the Cities of Richardson, Plano, and Allen, as applicable.

Bill the ITS electrical service power usage to the Texas Department of Transportation.

For each ground box and electrical service on this project that are interconnected by conduits used for future use, in which cable is added or removed, affix a tag to the cabling remaining in the box clearly stating the box contains cabling which is supplied by more than one power source. Ensure each tag is laminated and has minimum dimensions.

The State will supply the Type A electrical service enclosures and granite concrete poles for roadway illumination as shown in the plans. The materials were ordered in July 2023 and TxDOT will notify the contractor once fabrication is complete and the materials have been delivered to TxDOT. The Contractor shall contact the District Signal Shop at (214)320-6682 to schedule a date and time to pick up materials. A minimum advance notice of two working days is required.

The Contractor shall be responsible for any additional materials required by the specifications for Item 628 “Electrical Services”. In addition, all construction shall be in accordance Item 628, Article 3.1 “Installation”. This price for each installation is full compensation for paying all fees, permits, and other costs; making arrangements with the utility company for all work and materials provided by the utility company; installing State-supplied poles and service enclosures; furnishing, installing, and connecting all components including service supports, foundations, anchor bolts, riprap, service conduit (from the service equipment including the elbow below ground), fittings, service conductors (from the service equipment including the elbow below ground), brackets, bolts, hangers, hardware; and materials, equipment, labor, tools, and incidentals.

Item 636:

Leave the advance guide sign and/or the exit direction sign for an interchange in place at all times unless prior written approval is given. Replace signs removed by the Contractor before the end of the work day.

Manufacture all white legends using Clearview font on overhead and large ground-mounted guide signs. This includes destinations, cardinal directions, exit information and exit numbers. Use the font shown on the current standard sheets for all route markers (including interstate shields) and “Exit Only” panel information. Letter, arrow, and number heights shall all conform to the latest edition of the Standard Highway Sign Design Manual.

Provide two (2) sets of shop drawings for signs. The shop drawings shall conform to the details shown on the plans. The shop drawings shall show the details of the panels, wind beams, stiffeners, joint backing plates, splices, fasteners, brackets, and sign support connections. The shop drawings shall show letter types and sizes, interline spacing and message arrangements.

Affix a sign identification decal to the back of all signs and mark out the installation date in accordance with Item 643.

Attach sheeting applied to extruded aluminum panels to each individual extrusion.

All new and or replaced sign panels shall be mounted flush (0º) on all sign structures. Furnish and obtain approval of all shop drawings detailing the method to accomplish this installation. All material and labor required for this special installation is considered subsidiary to Item 636.

Ensure the minimum vertical clearance, as shown in the plans, at the highpoint of the roadway after the installation of all overhead signs. Mount new overhead signs with 46% of the sign height positioned below the centerline of the truss. If new signs are mounted on a truss with

existing signs, all signs shall be bottom justified using the 46% of the tallest sign to determine placement.

Place new guide signs on existing overhead sign structures and bridge rail supports. Existing attachment hardware may be reused if position of sign meets the 46% mounting criteria and if the existing hardware is large enough to accommodate the new sign. Sign support brackets may be cut or removed as directed; however, do not extend or lengthen existing brackets. Furnish any additional sign attachment hardware, support brackets, etc. as required. Payment will not be made for the additional brackets, but is considered subsidiary to this Item.

All additional hat signs and plaques mounted to the top of signs shall be supported with wind beams 2.5 times the height of the sign and/or plaque.

Logo signs may be affected within the limits of this project. The statewide Logo sign program is managed for TxDOT by Lonestar Logos (www.lonestarlogos.com) under a separate contract. If Logo signs need to be relocated or removed during construction, plans (traffic control plans and signing layouts) will clarify if the contractor is to do this or if the signs are to be relocated or removed by Lonestar Logos. In some cases, smaller replacement signs may be noted. All Logo signs are property of TxDOT.

The telephone number for Lonestar Logos is (512)462-1310 and the email address for the operations manager, Tyler Starr, is tstarr@lonestarlogos.com. Contact Lonestar Logos at least 2 weeks in advance of any needed removal or replacement of Logo signs.

Signs to be relocated during construction by the contractor will be paid under a separate pay item and in accordance with the Temporary Large Roadside Signs (TLRS) standard sheets in the plans.

Items 644, 647, and 650:
Prior to taking elevations to determine lengths for fabrication of sign posts and/or sign support towers, obtain verification of all proposed locations.

The post lengths shown on the Summary of Large Signs are approximations only. After the "X" dimensions are determined, submit actual post lengths to the Engineer for approval. Post lengths and size shall be approved by the Engineer before fabrication.

Item 650:
All towers and trusses will be match marked, by the fabricator, for erection. Use the tower heights shown in the sign summaries and on the plans for bidding purposes only. Prior to fabrication, take finished grade elevations at the tower locations and determine their exact heights for fabrication in accordance with the details shown on the plans.

Item 677:
A water blasting method approved by the Engineer will be the only method allowed for the removal of permanent and temporary pavement markings except on a sealcoat surface. A 2 foot wide sealcoat will be required on sealcoat surfaces to eliminate permanent and temporary pavement markings.

County: Collin

Highway: US 75

Item 730:
At the discretion of the Engineer, mow non-paved areas within the project prior to placement of permanent vegetation. Mow up to three (3) cycles per growing season.

Item 6000: Illumination Maintenance
New circuit breakers for existing electrical services shall be furnished by the Contractor and shall be compatible with the existing service equipment. A Licensed Master Electrician or Unrestricted Journeyman shall be required to make modifications to existing services.

Item 6007: Fiber Optic Cable
The single mode fiber optic cable will be installed continuous, without splices, from the communications hub to hub, as indicated in the plans, or as directed. No splicing of fiber optic cable will be permitted in ground boxes unless shown in the plans.

All fiber optic trunk cables and the insulated tracer wires will be installed in multiduct conduit. Electrical conductors will be installed in one three-inch conduit (or 2 inch conduit if shown on plans) and any non-fiber communications cables are to be installed in the second three-inch conduit (or 2 inch conduit if shown on plans).

All fiber optic pigtails and patch cords for general purpose ITS shall have ST connectors, will not be paid for separately, and shall be considered subsidiary to Item 6007.

All fiber optic pigtails and patch cords for gantry operations shall have LC connectors, will not be paid for separately, and shall be considered subsidiary to Item 6007.

Extra cable length will be included in each run, to provide adequate slack, at each ground box, camera pole, communications hub, dynamic message sign, or radar vehicle sensing device, as determined or shown in the plans.

Existing cables to be removed and salvaged shall be neatly coiled and strapped. Salvaged cables shall be delivered to the TxDOT Cedar Hill Maintenance Yard or as directed by the Engineer.

Item 6010: CCTV Field Equipment
The cables and harnesses will enter at the bottom of the CCTV housing. The CCTV will have gaskets, at entry points, to prevent moisture entry.
For LBJIG locations the following equipment is required:

Bosch CCTV
Fixed: FLEXIDOME IP starlight 8000i (CPP 7.3)
PTZ: MIC inteox 7100i (CPP 13

Item 6027: Preparation of Existing Conduits, Ground Boxes, or Manholes:
The Contractor is responsible for damage done to existing cable during the preparation of existing conduit. The Contractor will repair or replace damage done to existing cables. The repairing or replacing of damage to existing cables will be done at the expense of the Contractor, and to the satisfaction of the Engineer.

Item 6032: System Integration

This item includes the installation of state furnished Ethernet Switches, Port Expanders and Terminal Servers. The furnishing and installation of Ethernet Switch power cables and fiber optic jumper cables will also be considered subsidiary to this item

Item 6049: Longitudinal Channelizing Mountable Curb System

Remove all existing HOV Separator Pylons within the project. All pylons, mountable channelizing curb and foundation bolts shall become the property of the contractor and disposed of at his own expense.

All HOV Separator Pylon connection bolts shall be removed from the pavement and holes epoxy filled as directed by the engineer. Additional pavement repair, if necessary due to removal of channelizing mountable curb or pylon foundation bolts, shall be as directed by the Engineer and subsidiary to Item 6049.

HOV Separator Pylon removal will be measured along c/l US 75 and are located within the following station ranges on the project:

SB US 75	NB US 75
93+00 (BK) to 306+50 (BK)	93+00 (BK) to 306+50 (BK)
344+00 (AH) to 493+50 (AH)	338+00 (AH) to 500+00 (AH)

Item 6058:

For LBJIG locations the following equipment is required:

Alpha FXM 650 - PN 017-232-31

Item 6093: Existing Traffic Management Equipment

Existing cables and conductors for equipment to be removed and salvaged shall not be cut at the equipment entry points, but shall be cut at the maximum practical distance from the equipment to allow for reuse. Cables shall be neatly coiled and strapped as part of the salvaged equipment. Salvaged equipment shall be delivered to the TxDOT Cedar Hill Maintenance Yard or as directed by the Engineer.

Existing DMS signs shall become the property of the Contractor after TxDOT directed salvageable parts have been removed by the Contractor and delivered to TxDOT.

TransGuide shall be considered to be DalTrans for this project.

Existing DMS's shown to be removed in the plans shall be considered Type 2 DMS's for this project.

Item 6156: LED High Mast Illumination Assemblies

Aircraft obstruction lights are not required for this project.

County: Collin

Highway: US 75

Item 6185:
The total number of truck mounted attenuators (TMAs) or trailer attenuators (TAs) required when utilizing the traffic control standards are shown in the tables below.

TCP 1 Series	Scenario	Required TMA/TA
(1-5)-18		1

TCP 2 Series	Scenario	Required TMA/TA
(2-6)-18	All	1

TCP 3 Series	Scenario			Required TMA/TA
(3-2)-13	All			3
(3-3)-14	A	B	D	2
	C			3

TCP 5 Series	Scenario		Required TMA/TA
(5-1)-18	A	B	1

TCP 6 Series	Scenario		Required TMA/TA	
(6-1)-12	A	B	1	2
(6-2)-12 / (6-3)-12	All		1	
(6-4)-12	A	B	1	2
(6-5)-12	A	B	1	2
(6-8)-14	All		1	

The contractor will be responsible for determining if one or more of these operations will be ongoing at the same time to determine the total number of TMAs/TAs needed for the project. Additional TMAs/TAs used that are not specified in the plans in which the contractor expects compensation will require prior approval from the Engineer.

The TMA/TA used for installation/removal of traffic control for a work area will be subsidiary to the TMA/TA used to perform the work.

Item 6186: ITS Ground Box:
The Contractor shall provide a total of 4 keyed sockets for the locking security bolts for the project. This work will not be paid for directly, but is subsidiary to this Item.

Item 6304:
For LBJIG locations the following equipment is required:

Wavetronix: Smart Sensor HD (MVD) SS126

Item 6405 Ground Boxes:
Ground box (17x30x30) and stacked ground box (11x18x24) shall be constructed of polymer concrete in accordance with the barrier ground box detail located in the plans. Ensure two (2) one(1)-inch PVC drains are locacted in opposite corners, or located in the lowest corners of each ground box bottom to allow the ground box to drain properly. For the stacked ground box, provide top box with an open bottom and the bottom box with a closed bottom.

Item 6406 Lightning Protection System:
Install the lightning protection system in accordance with the Special Specification and as shown on plans. This work includes furnishing the grounding conductor, placing the grounding conductor in the lightning protection system conduits, bonding the grounding conductor to TZ footing reinforcing, terminating the grounding conductor in a Type D ground box with minimum 12 inches of slack for future connections, and extending the grounding conductor a minimum of 12 inches above the barrier, capping and storing the slack inside the conduit for future connections. The Type D ground box will be paid under Item 624 “Ground Boxes”.

Item 6406 Lightning Protection System:
Install the lightning protection system in accordance with the Special Specification and as shown on plans. This work includes furnishing the grounding conductor, placing the grounding conductor in the lightning protection system conduits, bonding the grounding conductor to TZ footing reinforcing, terminating the grounding conductor in a Type D ground box with minimum 12 inches of slack for future connections, and extending the grounding conductor a minimum of 12 inches above the barrier, capping and storing the slack inside the conduit for future connections. The Type D ground box will be paid under Item 624 “Ground Boxes”.

Item 6475 Hardened Ethernet Switch:
For LBJIG locations the following equipment is required:

Hirschmann - Rail Switch Rugged MN RSR30-08033OTT-SCCWBHSE3S

Item 6503 Amber Single Line Dynamic Message Sign System:
For LBJIG locations the following equipment is required:

Daktronics – Models VM-1028-7x35-66-A and VM-1028-7x50-66-A

CONTROL : 0047-06-158, ETC
PROJECT : STP 2024(041)MM
HIGHWAY : US 75
COUNTY : COLLIN, ETC

TEXAS DEPARTMENT OF TRANSPORTATION

GOVERNING SPECIFICATIONS AND SPECIAL PROVISIONS

ALL SPECIFICATIONS AND SPECIAL PROVISIONS APPLICABLE TO THIS PROJECT ARE IDENTIFIED AS FOLLOWS:

STANDARD SPECIFICATIONS: ADOPTED BY THE TEXAS DEPARTMENT OF TRANSPORTATION NOVEMBER 1, 2014. STANDARD SPECIFICATIONS ARE INCORPORATED INTO THE CONTRACT BY REFERENCE.

ITEMS 1 TO 9 INCL., GENERAL REQUIREMENTS AND COVENANTS
ITEM 100 PREPARING RIGHT OF WAY (103)
ITEM 104 REMOVING CONCRETE
ITEM 132 EMBANKMENT (100)(160)(204)(210)(216)(260)(400)
ITEM 160 TOPSOIL (168)
ITEM 161 COMPOST (160)
ITEM 162 SODDING FOR EROSION CONTROL (166)(168)
ITEM 164 SEEDING FOR EROSION CONTROL (162)(166)(168)
ITEM 168 VEGETATIVE WATERING
ITEM 247 FLEXIBLE BASE (105)(204)(210)(216)(520)
ITEM 360 CONCRETE PAVEMENT (421)(422)(438)(440)(529)(585)
ITEM 361 REPAIR OF CONCRETE PAVEMENT (360)(421)(440)
ITEM 403 TEMPORARY SPECIAL SHORING (410)(411)(423)
ITEM 416 DRILLED SHAFT FOUNDATIONS (405)(420)(421)(423)(440)(448)
ITEM 420 CONCRETE SUBSTRUCTURES (400)(404)(421)(422)(426)(427) (440)(441)(448)
ITEM 432 RIPRAP (247)(420)(421)(431)(440)
ITEM 451 RETROFIT RAILING (421)(429)(440)(442)(445)(446)(450)(540)
ITEM 500 MOBILIZATION
ITEM 502 BARRICADES, SIGNS, AND TRAFFIC HANDLING
ITEM 504 FIELD OFFICE AND LABORATORY
ITEM 506 TEMPORARY EROSION, SEDIMENTATION, AND ENVIRONMENTAL CONTROLS (161)(432)(556)
ITEM 512 PORTABLE TRAFFIC BARRIER (420)(421)(424)(440)(442)
ITEM 514 PERMANENT CONCRETE TRAFFIC BARRIER (400)(416)(420)(421) (424)(440)(442)(448)
ITEM 529 CONCRETE CURB, GUTTER, AND COMBINED CURB AND GUTTER (360) (420)(421)(440)
ITEM 533 MILLED RUMBLE STRIPS
ITEM 540 METAL BEAM GUARD FENCE (421)(441)(445)(529)

ITEM 542 REMOVING METAL BEAM GUARD FENCE
ITEM 544 GUARDRAIL END TREATMENTS
ITEM 545 CRASH CUSHION ATTENUATORS (421)
ITEM 610 ROADWAY ILLUMINATION ASSEMBLIES (416)(421)(432)(441)(442)
(445)(449)(614)(616)(618)(620)(622)(624)(628)
ITEM 613 HIGH MAST ILLUMINATION POLES
ITEM 614 HIGH MAST ILLUMINATION ASSEMBLIES (441)(442)(445)(613)
(616)(620)(628)
ITEM 617 TEMPORARY ROADWAY ILLUMINATION (416)(610)(613)(614)(618)
(620)(621)(622)(624)(627)(628)
ITEM 618 CONDUIT (400)(476)
ITEM 620 ELECTRICAL CONDUCTORS (610)(628)
ITEM 624 GROUND BOXES (420)(421)(432)(440)(618)(620)
ITEM 628 ELECTRICAL SERVICES (441)(445)(449)(618)(620)(627)(656)
ITEM 636 SIGNS (643)
ITEM 644 SMALL ROADSIDE SIGN ASSEMBLIES (421)(440)(441)(442)(445)
(636)(643)(656)
ITEM 647 LARGE ROADSIDE SIGN SUPPORTS AND ASSEMBLIES
ITEM 650 OVERHEAD SIGN SUPPORTS (416)(420)(421)(441)(442)(445)
(449)(618)(636)(654)
ITEM 658 DELINEATOR AND OBJECT MARKER ASSEMBLIES (445)
ITEM 662 WORK ZONE PAVEMENT MARKINGS (666)(668)(672)(677)
ITEM 666 RETROREFLECTORIZED PAVEMENT MARKINGS (316)(502)(662)(677)
(678)<6438>
ITEM 668 PREFABRICATED PAVEMENT MARKINGS (678)
ITEM 672 RAISED PAVEMENT MARKERS (677)(678)
ITEM 677 ELIMINATING EXISTING PAVEMENT MARKINGS AND MARKERS (300)
(302)(316)<3096>
ITEM 678 PAVEMENT SURFACE PREPARATION FOR MARKINGS (677)
ITEM 730 ROADSIDE MOWING
ITEM 734 LITTER REMOVAL
ITEM 735 DEBRIS REMOVAL (734)(738)
ITEM 738 CLEANING AND SWEEPING HIGHWAYS
ITEM 764 PUMP STATION AND DRAINAGE SYSTEM CLEANING

SPECIAL PROVISIONS: SPECIAL PROVISIONS WILL GOVERN AND TAKE
---------- PRECEDENCE OVER THE SPECIFICATIONS ENUMERATED
HEREON WHEREVER IN CONFLICT THEREWITH.

REQUIRED CONTRACT PROVISIONS, FEDERAL-AID CONSTRUCTION CONTRACTS
(FORM FHWA 1273)
WAGE RATES
SPECIAL PROVISION "NONDISCRIMINATION" (000---002)
SPECIAL PROVISION "CERTIFICATION OF NONDISCRIMINATION IN EMPLOYMENT"
(000---003)
SPECIAL PROVISION "NOTICE OF REQUIREMENT FOR AFFIRMATIVE ACTION TO
ENSURE EQUAL EMPLOYMENT OPPORTUNITY (EXECUTIVE
ORDER 11246" (000---004)
SPECIAL PROVISION "STANDARD FEDERAL EQUAL EMPLOYMENT OPPORTUNITY
CONSTRUCTION CONTRACT SPECIFICATIONS" (000---005)
SPECIAL PROVISION "ONTHEJOB TRAINING PROGRAM" (000---006)
SPECIAL PROVISION "CERTIFICATE OF INTERESTED PARTIES (FORM 1295)"

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                    (000--1019)
SPECIAL PROVISION "SCHEDULE OF LIQUIDATED DAMAGES" (000--1243)
SPECIAL PROVISION "CARGO PREFERENCE ACT REQUIREMENTS IN FEDERAL AID
                    CONTRACTS" (000---241)
SPECIAL PROVISION "DISADVANTAGED BUSINESS ENTERPRISE IN FEDERALAID
                    CONTRACTS" (000---394)
SPECIAL PROVISION "IMPORTANT NOTICE TO CONTRACTORS" (000---395)
SPECIAL PROVISION "NOTICE OF CONTRACTOR PERFORMANCE EVALUATIONS"
                    (000---659)
SPECIAL PROVISIONS TO ITEM     2  (002---009)(002---011)(002---013)
SPECIAL PROVISIONS TO ITEM     3  (003---005)(003---011)(003---013)
SPECIAL PROVISIONS TO ITEM     5  (005---002)(005---003)
SPECIAL PROVISIONS TO ITEM     6  (006---012)(006---030)
SPECIAL PROVISIONS TO ITEM     7  (007---004)(007---008)(007---010)
                                  (007---011)
SPECIAL PROVISIONS TO ITEM     8  (008---003)(008---030)(008---033)
SPECIAL PROVISIONS TO ITEM     9  (009---010)(009---011)
SPECIAL PROVISION  TO ITEM   247  (247---003)
SPECIAL PROVISION  TO ITEM   300  (300---020)
SPECIAL PROVISION  TO ITEM   302  (302---003)
SPECIAL PROVISION  TO ITEM   316  (316---002)
SPECIAL PROVISION  TO ITEM   360  (360---001)
SPECIAL PROVISION  TO ITEM   420  (420---001)
SPECIAL PROVISION  TO ITEM   421  (421---010)
SPECIAL PROVISION  TO ITEM   426  (426---005)
SPECIAL PROVISION  TO ITEM   427  (427---003)
SPECIAL PROVISION  TO ITEM   440  (440---004)
SPECIAL PROVISION  TO ITEM   441  (441---004)
SPECIAL PROVISION  TO ITEM   442  (442---001)
SPECIAL PROVISION  TO ITEM   446  (446---005)
SPECIAL PROVISION  TO ITEM   448  (448---001)
SPECIAL PROVISION  TO ITEM   449  (449---002)
SPECIAL PROVISION  TO ITEM   450  (450---001)
SPECIAL PROVISION  TO ITEM   465  (465---001)
SPECIAL PROVISION  TO ITEM   502  (502---008)
SPECIAL PROVISION  TO ITEM   506  (506---005)
SPECIAL PROVISION  TO ITEM   520  (520---002)
SPECIAL PROVISION  TO ITEM   540  (540---001)
SPECIAL PROVISION  TO ITEM   636  (636---001)
SPECIAL PROVISION  TO ITEM   643  (643---001)
SPECIAL PROVISION  TO ITEM   654  (654---001)
SPECIAL PROVISION  TO ITEM   656  (656---001)
SPECIAL PROVISION  TO ITEM   666  (666---007)
SPECIAL PROVISION  TO SPECIAL SPECIFICATION ITEM  6010  (6010--001)
SPECIAL PROVISION  TO SPECIAL SPECIFICATION ITEM  6064  (6064--001)
SPECIAL PROVISION  TO SPECIAL SPECIFICATION ITEM  6185  (6185--002)
SPECIAL PROVISION  TO SPECIAL SPECIFICATION ITEM  6407  (6407--001)


SPECIAL SPECIFICATIONS:
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ITEM 3096 ASPHALTS, OILS, AND EMULSIONS
ITEM 6000 ILLUMINATION MAINTENANCE
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ITEM 6001 PORTABLE CHANGEABLE MESSAGE SIGN
ITEM 6005 TESTING, TRAINING, DOCUMENTATION, FINAL ACCEPTANCE, AND WARRANTY
ITEM 6006 ELECTRONIC COMPONENTS
ITEM 6007 FIBER OPTIC CABLE (618)(620)(625)(6016)
ITEM 6008 ITS FIELD EQUIPMENT CABINET (421)(440)(449)(618)(620)(656)(687)(740)(6005)(6006)
ITEM 6010 CCTV FIELD EQUIPMENT (6005)(6006)
ITEM 6016 MULTI-DUCT CONDUIT SYSTEM (400)(401)(402)(421)(445)(476)(618)(620)
ITEM 6020 MULTIPOLYMER PAVEMENT MARKINGS (MPM) WITH WARRANTY (677)
ITEM 6027 PREPARATION OF EXISTING CONDUITS, GROUND BOXES, OR MANHOLES (465)(618)(624)
ITEM 6032 ITS SYSTEM INTEGRATION (6005)
ITEM 6049 LONGITUDINAL CHANNELIZING MOUNTABLE CURB SYSTEM
ITEM 6053 SHIFTING OR REMOVING EXISTING OVERHEAD SIGNS (636)(654)
ITEM 6058 BATTERY BACK-UP SYSTEM FOR SIGNAL CABINETS (420)(620)
ITEM 6064 INTELLIGENT TRANSPORTATION SY STEM (ITS) POLE WITH CABINET (416)(421)(440)(441)(442)(445)(449)(496)(618)(620)(740)
ITEM 6185 TRUCK MOUNTED ATTENUATOR (TMA) AND TRAILER ATTENUATOR (TA)
ITEM 6186 INTELLIGENT TRANSPORTATION SYSTEM(ITS) GROUND BOX (420)(421)(432)(440)(471)(618)(620)
ITEM 6277 INSTALL LARGE GROUND MOUNTED AND OVERHEAD SIGNS FURNISHED BY THE STATE
ITEM 6304 INTELLIGENT TRANSPORTATION SYSTEM (ITS) RADAR VEHICLE SENSING DEVICE
ITEM 6405 GROUND BOXES
ITEM 6406 LIGHTING PROTECTION SYSTEM
ITEM 6407 FULL COLOR LED VARIABLE MESSAGE SIGN SYSTEM
ITEM 6438 MOBILE RETROREFLECTIVITY DATA COLLECTION FOR PAVEMENT MARKINGS
ITEM 6475 HARDENED ETHERNET SWITCH TYPE 2 <6005>
ITEM 6503 AMBER SINGLE LINE DYNAMIC MESSAGE SIGN SYSTEM

GENERAL: THE ABOVE-LISTED SPECIFICATION ITEMS ARE THOSE UNDER WHICH
------- PAYMENT IS TO BE MADE. THESE, TOGETHER WITH SUCH OTHER PERTINENT ITEMS, IF ANY, AS MAY BE REFERRED TO IN THE ABOVE-LISTED SPECIFICATION ITEMS, AND INCLUDING THE SPECIAL PROVISIONS LISTED ABOVE, CONSTITUTE THE COMPLETE SPECIFICATIONS FOR THIS PROJECT.

Control	**0047-06-158, ETC.**
Project	**STP 2024(041)MM**
Highway	**US 75**
County	**COLLIN, ETC.**

DISADVANTAGED BUSINESS ENTERPRISE REQUIREMENTS

The following goal for disadvantaged business enterprises is established:

DBE
4.0%

Certification of DBE Goal Attainment

By signing the proposal, the Bidder certifies that the above DBE goal will be met by committing to DBE participation that meets or exceeds the goal or providing adequate documentation of good faith efforts (GFE) to achieve the goal.

The DBE participation or GFE must be submitted within five (5) calendar days after bid opening. If the fifth day falls on a weekend or a day when TxDOT offices are closed, the deadline moves to the next business day.

The Department may impose remedies as defined by state or local law if a bidder fails to submit required documentation, including forfeiting the bid proposal guaranty and exclusion from rebidding on the contract if it is re-advertised.

CHILD SUPPORT STATEMENT

Under Section 231.006, Family Code, the vendor or applicant certifies that the individual or business entity named in this contract, bid, or application is not ineligible to receive the specified grant, loan, or payment and acknowledges that this contract may be terminated and payment may be withheld if this certification is inaccurate.

CONFLICT OF INTEREST CERTIFICATION

Pursuant to Texas Government Code Section 2261.252(b), the Department is prohibited from entering into contracts in which Department officers and employees have a financial interest.

By signing the Contract, the Contractor certifies that it is not prohibited from entering into a Contract with the Department as a result of a financial interest as defined under Texas Government Code Section 2261.252(b), and that it will exercise reasonable care and diligence to prevent any actions or conditions that could result in a conflict of interest with the Department.

The Contractor also certifies that none of the following individuals, nor any of their family members within the second degree of affinity or consanguinity, owns 1% or more interest or has a financial interest as defined under Texas Government Code Section 2261.252(b) in the Contractor:

- Any member of the Texas Transportation Commission; and
- The Department's Executive Director, General Counsel, Chief of Procurement and Field Support Operations, Director of Procurement, and Director of Contract Services.

Violation of this certification may result in action by the Department.

E-VERIFY CERTIFICATION

Pursuant to Texas Transportation Code §223.051, all TxDOT contracts for construction, maintenance, or improvement of a highway must include a provision requiring Contractors and subcontractors to use the U.S. Department of Homeland Security's E-Verify system to determine employment eligibility. By signing the contract, the Contractor certifies that prior to the award of the Contract:

- the Contractor has registered with and will, to the extent permitted by law, utilize the United States Department of Homeland Security's E-Verify system during the term of the Contract to determine the eligibility of all persons hired to perform duties within Texas during the term of the agreement; and
- the Contractor will require that all subcontractors also register with and, to the extent permitted by law, utilize the United States Department of Homeland Security's E-Verify system during the term of the subcontract to determine the eligibility of all persons hired to perform duties within Texas during the term of the agreement.

Violation of this requirement constitutes a material breach of the Contract, subjects a subcontractor to removal from the Contract, and subjects the Contractor or subcontractors to possible sanctions in accordance with Title 43, Texas Administrative Code, Chapter 10, Subchapter F, "Sanctions and Suspension for Ethical Violations by Entities Doing Business with the Department."

Certification Regarding Disclosure of Public Information

Pursuant to Subchapter J, Chapter 552, Texas Government Code, contractors executing a contract with a governmental body that results in the expenditure of at least $1 million in public funds must:

1) preserve all contracting information* as provided by the records retention requirements applicable to Texas Department of Transportation (TxDOT) for the duration of the contract,
2) on request of TxDOT, promptly provide any contracting information related to the contract that is in the custody or possession of the entity, and
3) on completion of the contract, either:
    A. provide, at no cost to TxDOT, all contracting information related to the contract that is in the custody or possession of the entity, or
    B. preserve the contracting information related to the contract as provided by the records retention requirements applicable to TxDOT

The requirements of Subchapter J, Chapter 552, Government Code, may apply to this contract, and the contractor or vendor agrees that the contract can be terminated if the contractor or vendor knowingly or intentionally fails to comply with a requirement of that subchapter.

By entering into Contract, the Contractor agrees to:

- provide, or make available, to TxDOT and any authorized governmental investigating or auditing agency all records, including electronic and payment records related to the contract, for the same period provided by the records retention schedule applicable to TxDOT, and
- ensure that all subcontracts include a clause requiring the same.

* As defined in Government Code §552.003, "Contracting information" means the following information maintained by a governmental body or sent between a governmental body and a vendor, contractor, potential vendor, or potential contractor:

1) information in a voucher or contract relating to the receipt or expenditure of public funds by a governmental body;
2) solicitation or bid documents relating to a contract with a governmental body;
3) communications sent between a governmental body and a vendor, contractor, potential vendor, or potential contractor during the solicitation, evaluation, or negotiation of a contract;
4) documents, including bid tabulations, showing the criteria by which a governmental body evaluates each vendor, contractor, potential vendor, or potential contractor responding to a solicitation and, if applicable, an explanation of why the vendor or contractor was selected; and
5) communications and other information sent between a governmental body and a vendor or contractor related to the performance of a final contract with the governmental body or work performed on behalf of the governmental body.

CERTIFICATION TO NOT BOYCOTT ISRAEL

Pursuant to Texas Government Code §2271.002, the Department must include a provision requiring a written verification affirming that the Contractor does not boycott Israel, as defined in Government Code §808.001, and will not boycott Israel during the term of the contract. This provision applies to a contract that:

1) is with a Contractor that is not a sole proprietorship,
2) is with a Contractor with 10 or more full-time employees, and
3) has a value of $100,000 or more.

By signing the contract, the Contractor certifies that it does not boycott Israel and will not boycott Israel during the term of this contract. “Boycott” means refusing to deal with, terminating business activities with, or otherwise taking any action that is intended to penalize, inflict economic harm on, or limit commercial relations specifically with Israel, or with a person or entity doing business in Israel or in an Israeli-controlled territory, but does not include an action made for ordinary business purposes.

Violation of this certification may result in action by the Department.

CERTIFICATION TO NOT BOYCOTT ENERGY COMPANIES

Pursuant to Texas Government Code §2274.002, the Department must include a provision requiring a written verification affirming that the Contractor does not boycott energy companies, as defined in Government Code §809.001, and will not boycott energy companies during the term of the contract. This provision applies to a contract that:

1) is with a Contractor that is not a sole proprietorship,
2) is with a Contractor with 10 or more full-time employees, and
3) has a value of $100,000 or more.

By signing the contract, the Contractor certifies that it does not boycott energy companies and will not boycott energy companies during the term of this contract. “Boycott” means taking any action that is intended to penalize, inflict economic harm on, or limit commercial relations with a company because the company: (1) engages in the exploration, production, utilization, transportation, sale, or manufacturing of fossil fuel-based energy and does not commit or pledge to meet environmental standards beyond applicable federal and state law; or (2) does business with a company described by (1).

Violation of this certification may result in action by the Department.

CERTIFICATION TO NOT DISCRIMINATE AGAINST FIREARM ENTITIES OR FIREARM TRADE ASSOCIATIONS

Pursuant to Texas Government Code §2274.002, the Department must include a provision requiring a written verification affirming that the Contractor:

1) does not have a practice, policy, guidance, or directive that discriminates against a firearm entity or firearm trade association, as defined in Government Code §2274.001, and
2) will not discriminate against a firearm entity or firearm trade association during the term of the contract.

This provision applies to a contract that:

1) is with a Contractor that is not a sole proprietorship,
2) is with a Contractor with 10 or more full-time employees, and
3) has a value of $100,000 or more.

By signing the contract, the Contractor certifies that it does not discriminate against a firearm entity or firearm trade association as described and will not do so during the term of this contract. "Discriminate against a firearm entity or firearm trade association" means, with respect to the entity or association, to: (1) refuse to engage in the trade of any goods or services with the entity or association based solely on its status as a firearm entity or firearm trade association; (2) refrain from continuing an existing business relationship with the entity or association based solely on its status as a firearm entity or firearm trade association; or (3) terminate an existing business relationship with the entity or association based solely on its status as a firearm entity or firearm trade association. "Discriminate against a firearm entity or firearm trade association" does not include: (1) the established policies of a merchant, retail seller, or platform that restrict or prohibit the listing or selling of ammunition, firearms, or firearm accessories; (2) a company's refusal to engage in the trade of any goods or services, decision to refrain from continuing an existing business relationship, or decision to terminate an existing business relationship to comply with federal, state, or local law, policy, or regulations or a directive by a regulatory agency, or for any traditional business reason that is specific to the customer or potential customer and not based solely on an entity 's or association's status as a firearm entity or firearm trade association.

Violation of this certification may result in action by the Department.

PROHIBITION ON CERTAIN TELECOMMUNICATIONS EQUIPMENT OR SERVICES

The Federal Register Notice issued the Final Rule and states that the amendment to 2 CFR 200.216 is effective on August 13, 2020. The new 2 CFR 200.471 regulation provides clarity that the telecommunications and video surveillance costs associated with 2 CFR 200.216 are unallowable for services and equipment from these specific providers. OMB's Federal Register Notice includes the new 2 CFR 200.216 and 2 CFR 200.471 regulations.

https://www.federalregister.gov/documents/2020/08/13/2020-17468/guidance-for-grants-and-agreements

Per the Federal Law referenced above, use of services, systems, or services or systems that contain components produced by any of the following manufacturers is strictly prohibited for use on this project. Therefore, for any telecommunications, CCTV, or video surveillance equipment, services or systems cannot be manufactured by, or have components manufactured by:

- Huawei Technologies Company,
- ZTE Corporation (any subsidiary and affiliate of such entities),
- Hyatera Communications Corporation,
- Hangzhou Hikvision Digital Technology Company,
- Dahua Technology Company (any subsidiary and affiliate of such entities).

Violation of this prohibition will require replacement of the equipment at the contractor's expense.

REQUIRED CONTRACT PROVISIONS
FEDERAL-AID CONSTRUCTION CONTRACTS

I. GENERAL

1. Form FHWA-1273 must be physically incorporated in each construction contract funded under title 23, United States Code, as required in 23 CFR 633.102(b) (excluding emergency contracts solely intended for debris removal). The contractor (or subcontractor) must insert this form in each subcontract and further require its inclusion in all lower tier subcontracts (excluding purchase orders, rental agreements and other agreements for supplies or services). 23 CFR 633.102(e).

The applicable requirements of Form FHWA-1273 are incorporated by reference for work done under any purchase order, rental agreement or agreement for other services. The prime contractor shall be responsible for compliance by any subcontractor, lower-tier subcontractor or service provider. 23 CFR 633.102(e).

Form FHWA-1273 must be included in all Federal-aid design-build contracts, in all subcontracts and in lower tier subcontracts (excluding subcontracts for design services, purchase orders, rental agreements and other agreements for supplies or services) in accordance with 23 CFR 633.102. The design-builder shall be responsible for compliance by any subcontractor, lower-tier subcontractor or service provider.

Contracting agencies may reference Form FHWA-1273 in solicitation-for-bids or request-for-proposals documents, however, the Form FHWA-1273 must be physically incorporated (not referenced) in all contracts, subcontracts and lower-tier subcontracts (excluding purchase orders, rental agreements and other agreements for supplies or services related to a construction contract). 23 CFR 633.102(b).

2. Subject to the applicability criteria noted in the following sections, these contract provisions shall apply to all work performed on the contract by the contractor's own organization and with the assistance of workers under the contractor's immediate superintendence and to all work performed on the contract by piecework, station work, or by subcontract. 23 CFR 633.102(d).

3. A breach of any of the stipulations contained in these Required Contract Provisions may be sufficient grounds for withholding of progress payments, withholding of final payment, termination of the contract, suspension / debarment or any other action determined to be appropriate by the contracting agency and FHWA.

4. Selection of Labor: During the performance of this contract, the contractor shall not use convict labor for any purpose within the limits of a construction project on a Federal-aid highway unless it is labor performed by convicts who are on parole, supervised release, or probation. 23 U.S.C. 114(b). The term Federal-aid highway does not include roadways functionally classified as local roads or rural minor collectors. 23 U.S.C. 101(a).

II. NONDISCRIMINATION (23 CFR 230.107(a); 23 CFR Part 230, Subpart A, Appendix A; EO 11246)

The provisions of this section related to 23 CFR Part 230, Subpart A, Appendix A are applicable to all Federal-aid construction contracts and to all related construction subcontracts of $10,000 or more. The provisions of 23 CFR Part 230 are not applicable to material supply, engineering, or architectural service contracts.

In addition, the contractor and all subcontractors must comply with the following policies: Executive Order 11246, 41 CFR Part 60, 29 CFR Parts 1625-1627, 23 U.S.C. 140, Section 504 of the Rehabilitation Act of 1973, as amended (29 U.S.C. 794), Title VI of the Civil Rights Act of 1964, as amended (42 U.S.C. 2000d et seq.), and related regulations including 49 CFR Parts 21, 26, and 27; and 23 CFR Parts 200, 230, and 633.

The contractor and all subcontractors must comply with: the requirements of the Equal Opportunity Clause in 41 CFR 60-1.4(b) and, for all construction contracts exceeding $10,000, the Standard Federal Equal Employment Opportunity Construction Contract Specifications in 41 CFR 60-4.3.

Note: The U.S. Department of Labor has exclusive authority to determine compliance with Executive Order 11246 and the policies of the Secretary of Labor including 41 CFR Part 60, and 29 CFR Parts 1625-1627. The contracting agency and the FHWA have the authority and the responsibility to ensure compliance with 23 U.S.C. 140, Section 504 of the Rehabilitation Act of 1973, as amended (29 U.S.C. 794), and Title VI of the Civil Rights Act of 1964, as amended (42 U.S.C. 2000d et seq.), and related regulations including 49 CFR Parts 21, 26, and 27; and 23 CFR Parts 200, 230, and 633.

The following provision is adopted from 23 CFR Part 230, Subpart A, Appendix A, with appropriate revisions to conform to the U.S. Department of Labor (US DOL) and FHWA requirements.

1. Equal Employment Opportunity: Equal Employment Opportunity (EEO) requirements not to discriminate and to take affirmative action to assure equal opportunity as set forth under laws, executive orders, rules, regulations (*see* 28 CFR Part 35, 29 CFR Part 1630, 29 CFR Parts 1625-1627, 41 CFR Part 60 and 49 CFR Part 27) and orders of the Secretary of Labor as modified by the provisions prescribed herein, and imposed pursuant to 23 U.S.C. 140, shall constitute the EEO and specific affirmative action standards for the contractor's project activities under this contract. The provisions of the Americans with Disabilities Act of 1990 (42 U.S.C. 12101 et seq.) set forth under 28 CFR Part 35 and 29 CFR Part 1630 are incorporated by reference in this contract. In the execution of this contract, the contractor agrees to comply with the following minimum specific requirement activities of EEO:

a. The contractor will work with the contracting agency and the Federal Government to ensure that it has made every good faith effort to provide equal opportunity with respect to all of its terms and conditions of employment and in their review of activities under the contract. 23 CFR 230.409 (g)(4) & (5).

b. The contractor will accept as its operating policy the following statement:

> "It is the policy of this Company to assure that applicants are employed, and that employees are treated during employment, without regard to their race, religion, sex, sexual orientation, gender identity, color, national origin, age or disability. Such action shall include: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship, pre-apprenticeship, and/or on-the-job training."

2. EEO Officer: The contractor will designate and make known to the contracting officers an EEO Officer who will have the responsibility for and must be capable of effectively administering and promoting an active EEO program and who must be assigned adequate authority and responsibility to do so.

3. Dissemination of Policy: All members of the contractor's staff who are authorized to hire, supervise, promote, and discharge employees, or who recommend such action or are substantially involved in such action, will be made fully cognizant of and will implement the contractor's EEO policy and contractual responsibilities to provide EEO in each grade and classification of employment. To ensure that the above agreement will be met, the following actions will be taken as a minimum:

a. Periodic meetings of supervisory and personnel office employees will be conducted before the start of work and then not less often than once every six months, at which time the contractor's EEO policy and its implementation will be reviewed and explained. The meetings will be conducted by the EEO Officer or other knowledgeable company official.

b. All new supervisory or personnel office employees will be given a thorough indoctrination by the EEO Officer, covering all major aspects of the contractor's EEO obligations within thirty days following their reporting for duty with the contractor.

c. All personnel who are engaged in direct recruitment for the project will be instructed by the EEO Officer in the contractor's procedures for locating and hiring minorities and women.

d. Notices and posters setting forth the contractor's EEO policy will be placed in areas readily accessible to employees, applicants for employment and potential employees.

e. The contractor's EEO policy and the procedures to implement such policy will be brought to the attention of employees by means of meetings, employee handbooks, or other appropriate means.

4. Recruitment: When advertising for employees, the contractor will include in all advertisements for employees the notation: "An Equal Opportunity Employer." All such advertisements will be placed in publications having a large circulation among minorities and women in the area from which the project work force would normally be derived.

a. The contractor will, unless precluded by a valid bargaining agreement, conduct systematic and direct recruitment through public and private employee referral sources likely to yield qualified minorities and women. To meet this requirement, the contractor will identify sources of potential minority group employees and establish with such identified sources procedures whereby minority and women applicants may be referred to the contractor for employment consideration.

b. In the event the contractor has a valid bargaining agreement providing for exclusive hiring hall referrals, the contractor is expected to observe the provisions of that agreement to the extent that the system meets the contractor's compliance with EEO contract provisions. Where implementation of such an agreement has the effect of discriminating against minorities or women, or obligates the contractor to do the same, such implementation violates Federal nondiscrimination provisions.

c. The contractor will encourage its present employees to refer minorities and women as applicants for employment. Information and procedures with regard to referring such applicants will be discussed with employees.

5. Personnel Actions: Wages, working conditions, and employee benefits shall be established and administered, and personnel actions of every type, including hiring, upgrading, promotion, transfer, demotion, layoff, and termination, shall be taken without regard to race, color, religion, sex, sexual orientation, gender identity, national origin, age or disability. The following procedures shall be followed:

a. The contractor will conduct periodic inspections of project sites to ensure that working conditions and employee facilities do not indicate discriminatory treatment of project site personnel.

b. The contractor will periodically evaluate the spread of wages paid within each classification to determine any evidence of discriminatory wage practices.

c. The contractor will periodically review selected personnel actions in depth to determine whether there is evidence of discrimination. Where evidence is found, the contractor will promptly take corrective action. If the review indicates that the discrimination may extend beyond the actions reviewed, such corrective action shall include all affected persons.

d. The contractor will promptly investigate all complaints of alleged discrimination made to the contractor in connection with its obligations under this contract, will attempt to resolve such complaints, and will take appropriate corrective action

within a reasonable time. If the investigation indicates that the discrimination may affect persons other than the complainant, such corrective action shall include such other persons. Upon completion of each investigation, the contractor will inform every complainant of all of their avenues of appeal.

6. Training and Promotion:

a. The contractor will assist in locating, qualifying, and increasing the skills of minorities and women who are applicants for employment or current employees. Such efforts should be aimed at developing full journey level status employees in the type of trade or job classification involved.

b. Consistent with the contractor's work force requirements and as permissible under Federal and State regulations, the contractor shall make full use of training programs (i.e., apprenticeship and on-the-job training programs for the geographical area of contract performance). In the event a special provision for training is provided under this contract, this subparagraph will be superseded as indicated in the special provision. The contracting agency may reserve training positions for persons who receive welfare assistance in accordance with 23 U.S.C. 140(a).

c. The contractor will advise employees and applicants for employment of available training programs and entrance requirements for each.

d. The contractor will periodically review the training and promotion potential of employees who are minorities and women and will encourage eligible employees to apply for such training and promotion.

7. Unions: If the contractor relies in whole or in part upon unions as a source of employees, the contractor will use good faith efforts to obtain the cooperation of such unions to increase opportunities for minorities and women. 23 CFR 230.409. Actions by the contractor, either directly or through a contractor's association acting as agent, will include the procedures set forth below:

a. The contractor will use good faith efforts to develop, in cooperation with the unions, joint training programs aimed toward qualifying more minorities and women for membership in the unions and increasing the skills of minorities and women so that they may qualify for higher paying employment.

b. The contractor will use good faith efforts to incorporate an EEO clause into each union agreement to the end that such union will be contractually bound to refer applicants without regard to their race, color, religion, sex, sexual orientation, gender identity, national origin, age, or disability.

c. The contractor is to obtain information as to the referral practices and policies of the labor union except that to the extent such information is within the exclusive possession of the labor union and such labor union refuses to furnish such information to the contractor, the contractor shall so certify to the contracting agency and shall set forth what efforts have been made to obtain such information.

d. In the event the union is unable to provide the contractor with a reasonable flow of referrals within the time limit set forth in the collective bargaining agreement, the contractor will, through independent recruitment efforts, fill the employment vacancies without regard to race, color, religion, sex, sexual orientation, gender identity, national origin, age, or disability; making full efforts to obtain qualified and/or qualifiable minorities and women. The failure of a union to provide sufficient referrals (even though it is obligated to provide exclusive referrals under the terms of a collective bargaining agreement) does not relieve the contractor from the requirements of this paragraph. In the event the union referral practice prevents the contractor from meeting the obligations pursuant to Executive Order 11246, as amended, and these special provisions, such contractor shall immediately notify the contracting agency.

8. Reasonable Accommodation for Applicants / Employees with Disabilities: The contractor must be familiar with the requirements for and comply with the Americans with Disabilities Act and all rules and regulations established thereunder. Employers must provide reasonable accommodation in all employment activities unless to do so would cause an undue hardship.

9. Selection of Subcontractors, Procurement of Materials and Leasing of Equipment: The contractor shall not discriminate on the grounds of race, color, religion, sex, sexual orientation, gender identity, national origin, age, or disability in the selection and retention of subcontractors, including procurement of materials and leases of equipment. The contractor shall take all necessary and reasonable steps to ensure nondiscrimination in the administration of this contract.

a. The contractor shall notify all potential subcontractors, suppliers, and lessors of their EEO obligations under this contract.

b. The contractor will use good faith efforts to ensure subcontractor compliance with their EEO obligations.

10. Assurances Required:

a. The requirements of 49 CFR Part 26 and the State DOT's FHWA-approved Disadvantaged Business Enterprise (DBE) program are incorporated by reference.

b. The contractor, subrecipient or subcontractor shall not discriminate on the basis of race, color, national origin, or sex in the performance of this contract. The contractor shall carry out applicable requirements of 49 CFR part 26 in the award and administration of DOT-assisted contracts. Failure by the contractor to carry out these requirements is a material breach of this contract, which may result in the termination of this contract or such other remedy as the recipient deems appropriate, which may include, but is not limited to:

(1) Withholding monthly progress payments;
(2) Assessing sanctions;
(3) Liquidated damages; and/or
(4) Disqualifying the contractor from future bidding as non-responsible.

c. The Title VI and nondiscrimination provisions of U.S. DOT Order 1050.2A at Appendixes A and E are incorporated by reference. 49 CFR Part 21.

11. Records and Reports: The contractor shall keep such records as necessary to document compliance with the EEO requirements. Such records shall be retained for a period of three years following the date of the final payment to the contractor for all contract work and shall be available at reasonable times and places for inspection by authorized representatives of the contracting agency and the FHWA.

a. The records kept by the contractor shall document the following:

(1) The number and work hours of minority and non-minority group members and women employed in each work classification on the project;

(2) The progress and efforts being made in cooperation with unions, when applicable, to increase employment opportunities for minorities and women; and

(3) The progress and efforts being made in locating, hiring, training, qualifying, and upgrading minorities and women.

b. The contractors and subcontractors will submit an annual report to the contracting agency each July for the duration of the project indicating the number of minority, women, and non-minority group employees currently engaged in each work classification required by the contract work. This information is to be reported on Form FHWA-1391. The staffing data should represent the project work force on board in all or any part of the last payroll period preceding the end of July. If on-the-job training is being required by special provision, the contractor will be required to collect and report training data. The employment data should reflect the work force on board during all or any part of the last payroll period preceding the end of July.

III. NONSEGREGATED FACILITIES

This provision is applicable to all Federal-aid construction contracts and to all related construction subcontracts of more than $10,000. 41 CFR 60-1.5.

As prescribed by 41 CFR 60-1.8, the contractor must ensure that facilities provided for employees are provided in such a manner that segregation on the basis of race, color, religion, sex, sexual orientation, gender identity, or national origin cannot result. The contractor may neither require such segregated use by written or oral policies nor tolerate such use by employee custom. The contractor's obligation extends further to ensure that its employees are not assigned to perform their services at any location under the contractor's control where the facilities are segregated. The term "facilities" includes waiting rooms, work areas, restaurants and other eating areas, time clocks, restrooms, washrooms, locker rooms and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing provided for employees. The contractor shall provide separate or single-user restrooms and necessary dressing or sleeping areas to assure privacy between sexes.

IV. DAVIS-BACON AND RELATED ACT PROVISIONS

This section is applicable to all Federal-aid construction projects exceeding $2,000 and to all related subcontracts and lower-tier subcontracts (regardless of subcontract size), in accordance with 29 CFR 5.5. The requirements apply to all projects located within the right-of-way of a roadway that is functionally classified as Federal-aid highway. 23 U.S.C. 113. This excludes roadways functionally classified as local roads or rural minor collectors, which are exempt. 23 U.S.C. 101. Where applicable law requires that projects be treated as a project on a Federal-aid highway, the provisions of this subpart will apply regardless of the location of the project. Examples include: Surface Transportation Block Grant Program projects funded under 23 U.S.C. 133 [excluding recreational trails projects], the Nationally Significant Freight and Highway Projects funded under 23 U.S.C. 117, and National Highway Freight Program projects funded under 23 U.S.C. 167.

The following provisions are from the U.S. Department of Labor regulations in 29 CFR 5.5 “Contract provisions and related matters” with minor revisions to conform to the FHWA-1273 format and FHWA program requirements.

1. Minimum wages (29 CFR 5.5)

a. All laborers and mechanics employed or working upon the site of the work, will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act (29 CFR part 3)), the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the contractor and such laborers and mechanics.

Contributions made or costs reasonably anticipated for bona fide fringe benefits under section 1(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of paragraph 1.d. of this section; also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs which cover the particular weekly period, are deemed to be constructively made or incurred during such weekly period. Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of work actually performed, without regard to skill, except as provided in 29 CFR 5.5(a)(4). Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein: Provided, That the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classification and wage rates conformed under paragraph 1.b. of this section) and the Davis-Bacon poster (WH–1321) shall be posted at all times by the contractor and its subcontractors at the site of the work in a prominent and accessible place where it can be easily seen by the workers.

b.(1) The contracting officer shall require that any class of laborers or mechanics, including helpers, which is not listed in the wage determination and which is to be employed under the contract shall be classified in conformance with the wage determination. The contracting officer shall approve an additional classification and wage rate and fringe benefits therefore only when the following criteria have been met:

(i) The work to be performed by the classification requested is not performed by a classification in the wage determination; and

(ii) The classification is utilized in the area by the construction industry; and

(iii) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.

(2) If the contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the contracting officer agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), a report of the action taken shall be sent by the contracting officer to the Administrator of the Wage and Hour Division, U.S. Department of Labor, Washington, DC 20210. The Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification action within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

(3) In the event the contractor, the laborers or mechanics to be employed in the classification or their representatives, and the contracting officer do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the contracting officer shall refer the questions, including the views of all interested parties and the recommendation of the contracting officer, to the Administrator for determination. The Administrator, or an authorized representative, will issue a determination within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

(4) The wage rate (including fringe benefits where appropriate) determined pursuant to paragraphs 1.b.(2) or 1.b.(3) of this section, shall be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.

c. Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.

d. If the contractor does not make payments to a trustee or other third person, the contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program, Provided, That the Secretary of Labor has found, upon the written request of the contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the contractor to set aside in a separate account assets for the meeting of obligations under the plan or program.

2. Withholding (29 CFR 5.5)

The contracting agency shall upon its own action or upon written request of an authorized representative of the Department of Labor, withhold or cause to be withheld from the contractor under this contract, or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to Davis-Bacon prevailing wage requirements, which is held by the same prime contractor, so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, and helpers, employed by the contractor or any subcontractor the full amount of wages required by the contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee, or helper, employed or working on the site of the work, all or part of the wages required by the contract, the contracting agency may, after written notice to the contractor, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

3. Payrolls and basic records (29 CFR 5.5)

a. Payrolls and basic records relating thereto shall be maintained by the contractor during the course of the work and preserved for a period of three years thereafter for all laborers and mechanics working at the site of the work. Such records shall contain the name, address, and social security number of each such worker, his or her correct classification, hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in section 1(b)(2)(B) of the Davis-Bacon Act), daily and weekly number of hours worked, deductions made and actual wages paid. Whenever the Secretary of Labor has found under 29 CFR 5.5(a)(1)(iv) that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in section 1(b)(2)(B) of the Davis-Bacon Act, the contractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs.

b.(1) The contractor shall submit weekly for each week in which any contract work is performed a copy of all payrolls to the contracting agency. The payrolls submitted shall set out accurately and completely all of the information required to be maintained under 29 CFR 5.5(a)(3)(i), except that full social security numbers and home addresses shall not be included on weekly transmittals. Instead the payrolls shall only need to include an individually identifying number for each employee (e.g., the last four digits of the employee's social security number). The required weekly payroll information may be submitted in any form desired. Optional Form WH–347 is available for this purpose from the Wage and Hour Division Web site. The prime contractor is responsible for the submission of copies of payrolls by all subcontractors. Contractors and subcontractors shall maintain the full social security number and current address of each covered worker, and shall provide them upon request to the contracting agency for transmission to the State DOT, the FHWA or the Wage and Hour Division of the Department of Labor for purposes of an investigation or audit of compliance with prevailing wage requirements. It is not a violation of this section for a prime contractor to require a subcontractor to provide addresses and social security numbers to the prime contractor for its own records, without weekly submission to the contracting agency.

(2) Each payroll submitted shall be accompanied by a "Statement of Compliance," signed by the contractor or

subcontractor or his or her agent who pays or supervises the payment of the persons employed under the contract and shall certify the following:

(i) That the payroll for the payroll period contains the information required to be provided under 29 CFR 5.5(a)(3)(ii), the appropriate information is being maintained under 29 CFR 5.5(a)(3)(i), and that such information is correct and complete;

(ii) That each laborer or mechanic (including each helper, apprentice, and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in 29 CFR part 3;

(iii) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed, as specified in the applicable wage determination incorporated into the contract.

(3) The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH–347 shall satisfy the requirement for submission of the "Statement of Compliance" required by paragraph 3.b.(2) of this section.

(4) The falsification of any of the above certifications may subject the contractor or subcontractor to civil or criminal prosecution under 18 U.S.C. 1001 and 31 U.S.C. 231.

c. The contractor or subcontractor shall make the records required under paragraph 3.a. of this section available for inspection, copying, or transcription by authorized representatives of the contracting agency, the State DOT, the FHWA, or the Department of Labor, and shall permit such representatives to interview employees during working hours on the job. If the contractor or subcontractor fails to submit the required records or to make them available, the FHWA may, after written notice to the contractor, the contracting agency or the State DOT, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR 5.12.

4. Apprentices and trainees (29 CFR 5.5)

a. Apprentices (programs of the USDOL).

Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Office of Apprenticeship Training, Employer and Labor Services, or with a State Apprenticeship Agency recognized by the Office, or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Office of Apprenticeship Training, Employer and Labor Services or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice.

The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated above, shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a contractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the contractor's or subcontractor's registered program shall be observed.

Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeymen hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination.

In the event the Office of Apprenticeship Training, Employer and Labor Services, or a State Apprenticeship Agency recognized by the Office, withdraws approval of an apprenticeship program, the contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

b. Trainees (programs of the USDOL).

Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration.

The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration.

Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed on the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the

corresponding journeyman wage rate on the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed.

In the event the Employment and Training Administration withdraws approval of a training program, the contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

c. Equal employment opportunity. The utilization of apprentices, trainees and journeymen under this part shall be in conformity with the equal employment opportunity requirements of Executive Order 11246, as amended, and 29 CFR part 30.

d. Apprentices and Trainees (programs of the U.S. DOT).

Apprentices and trainees working under apprenticeship and skill training programs which have been certified by the Secretary of Transportation as promoting EEO in connection with Federal-aid highway construction programs are not subject to the requirements of paragraph 4 of this Section IV. 23 CFR 230.111(e)(2). The straight time hourly wage rates for apprentices and trainees under such programs will be established by the particular programs. The ratio of apprentices and trainees to journeymen shall not be greater than permitted by the terms of the particular program.

5. Compliance with Copeland Act requirements. The contractor shall comply with the requirements of 29 CFR part 3, which are incorporated by reference in this contract as provided in 29 CFR 5.5.

6. Subcontracts. The contractor or subcontractor shall insert Form FHWA-1273 in any subcontracts and also require the subcontractors to include Form FHWA-1273 in any lower tier subcontracts. The prime contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all the contract clauses in 29 CFR 5.5.

7. Contract termination: debarment. A breach of the contract clauses in 29 CFR 5.5 may be grounds for termination of the contract, and for debarment as a contractor and a subcontractor as provided in 29 CFR 5.12.

8. Compliance with Davis-Bacon and Related Act requirements. All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 CFR parts 1, 3, and 5 are herein incorporated by reference in this contract as provided in 29 CFR 5.5.

9. Disputes concerning labor standards. As provided in 29 CFR 5.5, disputes arising out of the labor standards provisions of this contract shall not be subject to the general disputes clause of this contract. Such disputes shall be resolved in accordance with the procedures of the Department of Labor set forth in 29 CFR parts 5, 6, and 7. Disputes within the meaning of this clause include disputes between the contractor (or any of its subcontractors) and the contracting agency, the U.S. Department of Labor, or the employees or their representatives.

10. Certification of eligibility (29 CFR 5.5)

a. By entering into this contract, the contractor certifies that neither it (nor he or she) nor any person or firm who has an interest in the contractor's firm is a person or firm ineligible to be awarded Government contracts by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

b. No part of this contract shall be subcontracted to any person or firm ineligible for award of a Government contract by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

c. The penalty for making false statements is prescribed in the U.S. Criminal Code, 18 U.S.C. 1001.

V. CONTRACT WORK HOURS AND SAFETY STANDARDS ACT

Pursuant to 29 CFR 5.5(b), the following clauses apply to any Federal-aid construction contract in an amount in excess of $100,000 and subject to the overtime provisions of the Contract Work Hours and Safety Standards Act. These clauses shall be inserted in addition to the clauses required by 29 CFR 5.5(a) or 29 CFR 4.6. As used in this paragraph, the terms laborers and mechanics include watchmen and guards.

1. Overtime requirements. No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic in any workweek in which he or she is employed on such work to work in excess of forty hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of forty hours in such workweek. 29 CFR 5.5.

2. Violation; liability for unpaid wages; liquidated damages. In the event of any violation of the clause set forth in paragraph 1 of this section, the contractor and any subcontractor responsible therefor shall be liable for the unpaid wages. In addition, such contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in paragraph 1 of this section, in the sum currently provided in 29 CFR 5.5(b)(2)* for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of forty hours without payment of the overtime wages required by the clause set forth in paragraph 1 of this section. 29 CFR 5.5.

* $27 as of January 23, 2019 (See 84 FR 213-01, 218) as may be adjusted annually by the Department of Labor; pursuant to the Federal Civil Penalties Inflation Adjustment Act of 1990).

3. Withholding for unpaid wages and liquidated damages. The FHWA or the contacting agency shall upon its own action or upon written request of an authorized representative of the Department of Labor withhold or cause to be withheld, from any moneys payable on account of work performed by the contractor or subcontractor under any such contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in paragraph 2 of this section. 29 CFR 5.5.

4. Subcontracts. The contractor or subcontractor shall insert in any subcontracts the clauses set forth in paragraphs 1 through 4 of this section and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in paragraphs 1 through 4 of this section. 29 CFR 5.5.

VI. SUBLETTING OR ASSIGNING THE CONTRACT

This provision is applicable to all Federal-aid construction contracts on the National Highway System pursuant to 23 CFR 635.116.

1. The contractor shall perform with its own organization contract work amounting to not less than 30 percent (or a greater percentage if specified elsewhere in the contract) of the total original contract price, excluding any specialty items designated by the contracting agency. Specialty items may be performed by subcontract and the amount of any such specialty items performed may be deducted from the total original contract price before computing the amount of work required to be performed by the contractor's own organization (23 CFR 635.116).

a. The term “perform work with its own organization” in paragraph 1 of Section VI refers to workers employed or leased by the prime contractor, and equipment owned or rented by the prime contractor, with or without operators. Such term does not include employees or equipment of a subcontractor or lower tier subcontractor, agents of the prime contractor, or any other assignees. The term may include payments for the costs of hiring leased employees from an employee leasing firm meeting all relevant Federal and State regulatory requirements. Leased employees may only be included in this term if the prime contractor meets all of the following conditions: (based on longstanding interpretation)

(1) the prime contractor maintains control over the supervision of the day-to-day activities of the leased employees;
(2) the prime contractor remains responsible for the quality of the work of the leased employees;
(3) the prime contractor retains all power to accept or exclude individual employees from work on the project; and
(4) the prime contractor remains ultimately responsible for the payment of predetermined minimum wages, the submission of payrolls, statements of compliance and all other Federal regulatory requirements.

b. "Specialty Items" shall be construed to be limited to work that requires highly specialized knowledge, abilities, or equipment not ordinarily available in the type of contracting organizations qualified and expected to bid or propose on the contract as a whole and in general are to be limited to minor components of the overall contract. 23 CFR 635.102.

2. Pursuant to 23 CFR 635.116(a), the contract amount upon which the requirements set forth in paragraph (1) of Section VI is computed includes the cost of material and manufactured products which are to be purchased or produced by the contractor under the contract provisions.

3. Pursuant to 23 CFR 635.116(c), the contractor shall furnish (a) a competent superintendent or supervisor who is employed by the firm, has full authority to direct performance of the work in accordance with the contract requirements, and is in charge of all construction operations (regardless of who performs the work) and (b) such other of its own organizational resources (supervision, management, and engineering services) as the contracting officer determines is necessary to assure the performance of the contract.

4. No portion of the contract shall be sublet, assigned or otherwise disposed of except with the written consent of the contracting officer, or authorized representative, and such consent when given shall not be construed to relieve the contractor of any responsibility for the fulfillment of the contract. Written consent will be given only after the contracting agency has assured that each subcontract is evidenced in writing and that it contains all pertinent provisions and requirements of the prime contract. (based on long-standing interpretation of 23 CFR 635.116).

5. The 30-percent self-performance requirement of paragraph (1) is not applicable to design-build contracts; however, contracting agencies may establish their own self-performance requirements. 23 CFR 635.116(d).

VII. SAFETY: ACCIDENT PREVENTION

This provision is applicable to all Federal-aid construction contracts and to all related subcontracts.

1. In the performance of this contract the contractor shall comply with all applicable Federal, State, and local laws governing safety, health, and sanitation (23 CFR Part 635). The contractor shall provide all safeguards, safety devices and protective equipment and take any other needed actions as it determines, or as the contracting officer may determine, to be reasonably necessary to protect the life and health of employees on the job and the safety of the public and to protect property in connection with the performance of the work covered by the contract. 23 CFR 635.108.

2. It is a condition of this contract, and shall be made a condition of each subcontract, which the contractor enters into pursuant to this contract, that the contractor and any subcontractor shall not permit any employee, in performance of the contract, to work in surroundings or under conditions which are unsanitary, hazardous or dangerous to his/her health or safety, as determined under construction safety and health standards (29 CFR Part 1926) promulgated by the Secretary of Labor, in accordance with Section 107 of the Contract Work Hours and Safety Standards Act (40 U.S.C. 3704). 29 CFR 1926.10.

3. Pursuant to 29 CFR 1926.3, it is a condition of this contract that the Secretary of Labor or authorized representative thereof, shall have right of entry to any site of contract performance to inspect or investigate the matter of compliance

with the construction safety and health standards and to carry out the duties of the Secretary under Section 107 of the Contract Work Hours and Safety Standards Act (40 U.S.C. 3704).

VIII. FALSE STATEMENTS CONCERNING HIGHWAY PROJECTS

This provision is applicable to all Federal-aid construction contracts and to all related subcontracts.

In order to assure high quality and durable construction in conformity with approved plans and specifications and a high degree of reliability on statements and representations made by engineers, contractors, suppliers, and workers on Federal-aid highway projects, it is essential that all persons concerned with the project perform their functions as carefully, thoroughly, and honestly as possible. Willful falsification, distortion, or misrepresentation with respect to any facts related to the project is a violation of Federal law. To prevent any misunderstanding regarding the seriousness of these and similar acts, Form FHWA-1022 shall be posted on each Federal-aid highway project (23 CFR Part 635) in one or more places where it is readily available to all persons concerned with the project:

18 U.S.C. 1020 reads as follows:

"Whoever, being an officer, agent, or employee of the United States, or of any State or Territory, or whoever, whether a person, association, firm, or corporation, knowingly makes any false statement, false representation, or false report as to the character, quality, quantity, or cost of the material used or to be used, or the quantity or quality of the work performed or to be performed, or the cost thereof in connection with the submission of plans, maps, specifications, contracts, or costs of construction on any highway or related project submitted for approval to the Secretary of Transportation; or

Whoever knowingly makes any false statement, false representation, false report or false claim with respect to the character, quality, quantity, or cost of any work performed or to be performed, or materials furnished or to be furnished, in connection with the construction of any highway or related project approved by the Secretary of Transportation; or

Whoever knowingly makes any false statement or false representation as to material fact in any statement, certificate, or report submitted pursuant to provisions of the Federal-aid Roads Act approved July 11, 1916, (39 Stat. 355), as amended and supplemented;

Shall be fined under this title or imprisoned not more than 5 years or both."

IX. IMPLEMENTATION OF CLEAN AIR ACT AND FEDERAL WATER POLLUTION CONTROL ACT (42 U.S.C. 7606; 2 CFR 200.88; EO 11738)

This provision is applicable to all Federal-aid construction contracts in excess of $150,000 and to all related subcontracts. 48 CFR 2.101; 2 CFR 200.326.

By submission of this bid/proposal or the execution of this contract or subcontract, as appropriate, the bidder, proposer, Federal-aid construction contractor, subcontractor, supplier, or vendor agrees to comply with all applicable standards, orders or regulations issued pursuant to the Clean Air Act (42 U.S.C. 7401-7671q) and the Federal Water Pollution Control Act, as amended (33 U.S.C. 1251-1387). Violations must be reported to the Federal Highway Administration and the Regional Office of the Environmental Protection Agency. 2 CFR Part 200, Appendix II.

The contractor agrees to include or cause to be included the requirements of this Section in every subcontract, and further agrees to take such action as the contracting agency may direct as a means of enforcing such requirements. 2 CFR 200.326.

X. CERTIFICATION REGARDING DEBARMENT, SUSPENSION, INELIGIBILITY AND VOLUNTARY EXCLUSION

This provision is applicable to all Federal-aid construction contracts, design-build contracts, subcontracts, lower-tier subcontracts, purchase orders, lease agreements, consultant contracts or any other covered transaction requiring FHWA approval or that is estimated to cost $25,000 or more – as defined in 2 CFR Parts 180 and 1200. 2 CFR 180.220 and 1200.220.

1**. Instructions for Certification – First Tier Participants:**

a. By signing and submitting this proposal, the prospective first tier participant is providing the certification set out below.

b. The inability of a person to provide the certification set out below will not necessarily result in denial of participation in this covered transaction. The prospective first tier participant shall submit an explanation of why it cannot provide the certification set out below. The certification or explanation will be considered in connection with the department or agency's determination whether to enter into this transaction. However, failure of the prospective first tier participant to furnish a certification or an explanation shall disqualify such a person from participation in this transaction. 2 CFR 180.320.

c. The certification in this clause is a material representation of fact upon which reliance was placed when the contracting agency determined to enter into this transaction. If it is later determined that the prospective participant knowingly rendered an erroneous certification, in addition to other remedies available to the Federal Government, the contracting agency may terminate this transaction for cause of default. 2 CFR 180.325.

d. The prospective first tier participant shall provide immediate written notice to the contracting agency to whom this proposal is submitted if any time the prospective first tier participant learns that its certification was erroneous when submitted or has become erroneous by reason of changed circumstances. 2 CFR 180.345 and 180.350.

e. The terms "covered transaction," "debarred," "suspended," "ineligible," "participant," "person," "principal," and "voluntarily excluded," as used in this clause, are defined in 2 CFR Parts 180, Subpart I, 180.900-180.1020, and 1200. “First Tier Covered Transactions” refers to any covered transaction between a recipient or subrecipient of Federal funds and a participant (such as the prime or general contract). “Lower Tier Covered Transactions” refers to any covered transaction under a First Tier Covered Transaction (such as subcontracts). “First Tier Participant” refers to the participant

who has entered into a covered transaction with a recipient or subrecipient of Federal funds (such as the prime or general contractor). "Lower Tier Participant" refers any participant who has entered into a covered transaction with a First Tier Participant or other Lower Tier Participants (such as subcontractors and suppliers).

f. The prospective first tier participant agrees by submitting this proposal that, should the proposed covered transaction be entered into, it shall not knowingly enter into any lower tier covered transaction with a person who is debarred, suspended, declared ineligible, or voluntarily excluded from participation in this covered transaction, unless authorized by the department or agency entering into this transaction. 2 CFR 180.330.

g. The prospective first tier participant further agrees by submitting this proposal that it will include the clause titled "Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion-Lower Tier Covered Transactions," provided by the department or contracting agency, entering into this covered transaction, without modification, in all lower tier covered transactions and in all solicitations for lower tier covered transactions exceeding the $25,000 threshold. 2 CFR 180.220 and 180.300.

h. A participant in a covered transaction may rely upon a certification of a prospective participant in a lower tier covered transaction that is not debarred, suspended, ineligible, or voluntarily excluded from the covered transaction, unless it knows that the certification is erroneous. 2 CFR 180.300; 180.320, and 180.325. A participant is responsible for ensuring that its principals are not suspended, debarred, or otherwise ineligible to participate in covered transactions. 2 CFR 180.335. To verify the eligibility of its principals, as well as the eligibility of any lower tier prospective participants, each participant may, but is not required to, check the System for Award Management website (https://www.sam.gov/). 2 CFR 180.300, 180.320, and 180.325.

i. Nothing contained in the foregoing shall be construed to require the establishment of a system of records in order to render in good faith the certification required by this clause. The knowledge and information of the prospective participant is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.

j. Except for transactions authorized under paragraph (f) of these instructions, if a participant in a covered transaction knowingly enters into a lower tier covered transaction with a person who is suspended, debarred, ineligible, or voluntarily excluded from participation in this transaction, in addition to other remedies available to the Federal Government, the department or agency may terminate this transaction for cause or default. 2 CFR 180.325.

* * * * *

2. Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion – First Tier Participants:

a. The prospective first tier participant certifies to the best of its knowledge and belief, that it and its principals:

(1) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participating in covered transactions by any Federal department or agency, 2 CFR 180.335;.

(2) Have not within a three-year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State, or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property, 2 CFR 180.800;

(3) Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State or local) with commission of any of the offenses enumerated in paragraph (a)(2) of this certification, 2 CFR 180.700 and 180.800; and

(4) Have not within a three-year period preceding this application/proposal had one or more public transactions (Federal, State or local) terminated for cause or default. 2 CFR 180.335(d).

(5) Are not a corporation that has been convicted of a felony violation under any Federal law within the two-year period preceding this proposal (USDOT Order 4200.6 implementing appropriations act requirements); and

(6) Are not a corporation with any unpaid Federal tax liability that has been assessed, for which all judicial and administrative remedies have been exhausted, or have lapsed, and that is not being paid in a timely manner pursuant to an agreement with the authority responsible for collecting the tax liability (USDOT Order 4200.6 implementing appropriations act requirements).

b. Where the prospective participant is unable to certify to any of the statements in this certification, such prospective participant should attach an explanation to this proposal. 2 CFR 180.335 and 180.340.

3. **Instructions for Certification - Lower Tier Participants:**

(Applicable to all subcontracts, purchase orders, and other lower tier transactions requiring prior FHWA approval or estimated to cost $25,000 or more - 2 CFR Parts 180 and 1200). 2 CFR 180.220 and 1200.220.

a. By signing and submitting this proposal, the prospective lower tier participant is providing the certification set out below.

b. The certification in this clause is a material representation of fact upon which reliance was placed when this transaction was entered into. If it is later determined that the prospective lower tier participant knowingly rendered an erroneous certification, in addition to other remedies available to the Federal Government, the department, or agency with which this transaction originated may pursue available remedies, including suspension and/or debarment.

c. The prospective lower tier participant shall provide immediate written notice to the person to which this proposal is submitted if at any time the prospective lower tier participant learns that its certification was erroneous by reason of changed circumstances. 2 CFR 180.365.

d. The terms "covered transaction," "debarred," "suspended," "ineligible," "participant," "person," "principal," and "voluntarily excluded," as used in this clause, are defined in 2 CFR Parts 180, Subpart I, 180.900 – 180.1020, and 1200. You may contact the person to which this proposal is

submitted for assistance in obtaining a copy of those regulations. “First Tier Covered Transactions” refers to any covered transaction between a recipient or subrecipient of Federal funds and a participant (such as the prime or general contract). “Lower Tier Covered Transactions” refers to any covered transaction under a First Tier Covered Transaction (such as subcontracts). “First Tier Participant” refers to the participant who has entered into a covered transaction with a recipient or subrecipient of Federal funds (such as the prime or general contractor). “Lower Tier Participant” refers any participant who has entered into a covered transaction with a First Tier Participant or other Lower Tier Participants (such as subcontractors and suppliers).

e. The prospective lower tier participant agrees by submitting this proposal that, should the proposed covered transaction be entered into, it shall not knowingly enter into any lower tier covered transaction with a person who is debarred, suspended, declared ineligible, or voluntarily excluded from participation in this covered transaction, unless authorized by the department or agency with which this transaction originated. 2 CFR 1200.220 and 1200.332.

f. The prospective lower tier participant further agrees by submitting this proposal that it will include this clause titled "Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion-Lower Tier Covered Transaction," without modification, in all lower tier covered transactions and in all solicitations for lower tier covered transactions exceeding the $25,000 threshold. 2 CFR 180.220 and 1200.220.

g. A participant in a covered transaction may rely upon a certification of a prospective participant in a lower tier covered transaction that is not debarred, suspended, ineligible, or voluntarily excluded from the covered transaction, unless it knows that the certification is erroneous. A participant is responsible for ensuring that its principals are not suspended, debarred, or otherwise ineligible to participate in covered transactions. To verify the eligibility of its principals, as well as the eligibility of any lower tier prospective participants, each participant may, but is not required to, check the System for Award Management website (https://www.sam.gov/), which is compiled by the General Services Administration. 2 CFR 180.300, 180.320, 180.330, and 180.335.

h. Nothing contained in the foregoing shall be construed to require establishment of a system of records in order to render in good faith the certification required by this clause. The knowledge and information of participant is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.

i. Except for transactions authorized under paragraph e of these instructions, if a participant in a covered transaction knowingly enters into a lower tier covered transaction with a person who is suspended, debarred, ineligible, or voluntarily excluded from participation in this transaction, in addition to other remedies available to the Federal Government, the department or agency with which this transaction originated may pursue available remedies, including suspension and/or debarment. 2 CFR 180.325.

* * * * *

Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion--Lower Tier Participants:

1. The prospective lower tier participant certifies, by submission of this proposal, that neither it nor its principals:

(a) is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participating in covered transactions by any Federal department or agency, 2 CFR 180.355;

(b) is a corporation that has been convicted of a felony violation under any Federal law within the two-year period preceding this proposal (USDOT Order 4200.6 implementing appropriations act requirements); and

(c) is a corporation with any unpaid Federal tax liability that has been assessed, for which all judicial and administrative remedies have been exhausted, or have lapsed, and that is not being paid in a timely manner pursuant to an agreement with the authority responsible for collecting the tax liability. (USDOT Order 4200.6 implementing appropriations act requirements)

2. Where the prospective lower tier participant is unable to certify to any of the statements in this certification, such prospective participant should attach an explanation to this proposal.

* * * * *

XI. CERTIFICATION REGARDING USE OF CONTRACT FUNDS FOR LOBBYING

This provision is applicable to all Federal-aid construction contracts and to all related subcontracts which exceed $100,000. 49 CFR Part 20, App. A.

1. The prospective participant certifies, by signing and submitting this bid or proposal, to the best of his or her knowledge and belief, that:

a. No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any Federal agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

b. If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any Federal agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

2. This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by 31 U.S.C. 1352. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

3. The prospective participant also agrees by submitting its bid or proposal that the participant shall require that the language of this certification be included in all lower tier

subcontracts, which exceed $100,000 and that all such recipients shall certify and disclose accordingly.

XII. USE OF UNITED STATES-FLAG VESSELS:

This provision is applicable to all Federal-aid construction contracts, design-build contracts, subcontracts, lower-tier subcontracts, purchase orders, lease agreements, or any other covered transaction. 46 CFR Part 381.

This requirement applies to material or equipment that is acquired for a specific Federal-aid highway project. 46 CFR 381.7. It is not applicable to goods or materials that come into inventories independent of an FHWA funded-contract.

When oceanic shipments (or shipments across the Great Lakes) are necessary for materials or equipment acquired for a specific Federal-aid construction project, the bidder, proposer, contractor, subcontractor, or vendor agrees:

1. To utilize privately owned United States-flag commercial vessels to ship at least 50 percent of the gross tonnage (computed separately for dry bulk carriers, dry cargo liners, and tankers) involved, whenever shipping any equipment, material, or commodities pursuant to this contract, to the extent such vessels are available at fair and reasonable rates for United States-flag commercial vessels. 46 CFR 381.7.

2. To furnish within 20 days following the date of loading for shipments originating within the United States or within 30 working days following the date of loading for shipments originating outside the United States, a legible copy of a rated, ‘on-board’ commercial ocean bill-of-lading in English for each shipment of cargo described in paragraph (b)(1) of this section to both the Contracting Officer (through the prime contractor in the case of subcontractor bills-of-lading) and to the Office of Cargo and Commercial Sealift (MAR-620), Maritime Administration, Washington, DC 20590. (MARAD requires copies of the ocean carrier's (master) bills of lading, certified onboard, dated, with rates and charges. These bills of lading may contain business sensitive information and therefore may be submitted directly to MARAD by the Ocean Transportation Intermediary on behalf of the contractor). 46 CFR 381.7.

ATTACHMENT A - EMPLOYMENT AND MATERIALS PREFERENCE FOR APPALACHIAN DEVELOPMENT HIGHWAY SYSTEM OR APPALACHIAN LOCAL ACCESS ROAD CONTRACTS (23 CFR 633, Subpart B, Appendix B) This provision is applicable to all Federal-aid projects funded under the Appalachian Regional Development Act of 1965.

1. During the performance of this contract, the contractor undertaking to do work which is, or reasonably may be, done as on-site work, shall give preference to qualified persons who regularly reside in the labor area as designated by the DOL wherein the contract work is situated, or the subregion, or the Appalachian counties of the State wherein the contract work is situated, except:

a. To the extent that qualified persons regularly residing in the area are not available.

b. For the reasonable needs of the contractor to employ supervisory or specially experienced personnel necessary to assure an efficient execution of the contract work.

c. For the obligation of the contractor to offer employment to present or former employees as the result of a lawful collective bargaining contract, provided that the number of nonresident persons employed under this subparagraph (1c) shall not exceed 20 percent of the total number of employees employed by the contractor on the contract work, except as provided in subparagraph (4) below.

2. The contractor shall place a job order with the State Employment Service indicating (a) the classifications of the laborers, mechanics and other employees required to perform the contract work, (b) the number of employees required in each classification, (c) the date on which the participant estimates such employees will be required, and (d) any other pertinent information required by the State Employment Service to complete the job order form. The job order may be placed with the State Employment Service in writing or by telephone. If during the course of the contract work, the information submitted by the contractor in the original job order is substantially modified, the participant shall promptly notify the State Employment Service.

3. The contractor shall give full consideration to all qualified job applicants referred to him by the State Employment Service. The contractor is not required to grant employment to any job applicants who, in his opinion, are not qualified to perform the classification of work required.

4. If, within one week following the placing of a job order by the contractor with the State Employment Service, the State Employment Service is unable to refer any qualified job applicants to the contractor, or less than the number requested, the State Employment Service will forward a certificate to the contractor indicating the unavailability of applicants. Such certificate shall be made a part of the contractor's permanent project records. Upon receipt of this certificate, the contractor may employ persons who do not normally reside in the labor area to fill positions covered by the certificate, notwithstanding the provisions of subparagraph (1c) above.

5. The provisions of 23 CFR 633.207(e) allow the contracting agency to provide a contractual preference for the use of mineral resource materials native to the Appalachian region.

6. The contractor shall include the provisions of Sections 1 through 4 of this Attachment A in every subcontract for work which is, or reasonably may be, done as on-site work.

The wage rates listed herein are those predetermined by the Secretary of Labor and State Statue and listed in the United States Department of Labor's (USDOL) General Decisions dated **01-06-2023** and are the minimum wages to be paid accordingly for each specified classification. To determine the applicable wage rate zone, a list entitled "TEXAS COUNTIES IDENTIFIED BY WAGE RATE ZONES" is provided in the contract. Any wage rate that is not listed herein and not in the USDOL's general decision, must be submitted to the Engineer for approval. IMPORTANT NOTICE FOR STATE PROJECTS: only the controlling wage rate zone applies to the contract. Effective 01-06-2023.

CLASS. #	CLASSIFICATION DESCRIPTION	ZONE TX02 *(TX20230002)	ZONE TX03 *(TX20230003)	ZONE TX04 *(TX20230004)	ZONE TX05 *(TX20230005)	ZONE TX06 *(TX20230006)	ZONE TX07 *(TX20230007)	ZONE TX08 *(TX20230008)	ZONE TX24 *(TX20230024)	ZONE TX25 *(TX20230025)	ZONE TX27 *(TX20230027)	ZONE TX28 *(TX20230028)	ZONE TX29 *(TX20230029)	ZONE TX30 *(TX20230030)	ZONE TX37 *(TX20230037)	ZONE TX38 *(TX20230038)	ZONE TX42 *(TX20230042)
1428	Agricultural Tractor Operator						$12.69					$12.35			$11.75		
1300	Asphalt Distributor Operator	$14.87	$13.48	$13.88	$15.72	$15.58	$15.55	$15.72	$13.28	$15.32	$15.62	$14.36	$14.25	$14.03	$13.75	$14.06	$14.40
1303	Asphalt Paving Machine Operator	$13.40	$12.25	$12.35	$13.87	$14.05	$14.36	$14.20	$13.26	$13.99	$14.68	$12.92	$13.44	$12.53	$14.00	$14.32	$12.99
1106	Asphalt Raker	$12.28	$10.61	$12.02	$14.21	$11.65	$12.12	$11.64	$11.44	$12.69	$12.05	$11.34	$11.67	$11.40	$12.59	$12.36	$11.78
1112	Batching Plant Operator, Asphalt																
1115	Batching Plant Operator, Concrete																
1214	Blaster																
1615	Boom Truck Operator						$18.36										
1444	Boring Machine Operator																
1305	Broom or Sweeper Operator	$11.21	$10.33	$10.08	$11.99		$11.04	$11.62		$11.74	$11.41	$10.30		$10.23	$10.60	$12.68	$11.05
1144	Communications Cable Installer																
1124	Concrete Finisher, Paving and Structures	$13.55	$12.46	$13.16	$12.85	$12.64	$12.56	$12.77	$12.44	$14.12	$13.04	$13.38	$12.64	$12.80	$12.79	$12.98	$13.32
1318	Concrete Pavement Finishing Machine Operator				$16.05		$15.48			$16.05		$19.31				$13.07	
1315	Concrete Paving, Curing, Float, Texturing Machine Operator											$16.34				$11.71	
1333	Concrete Saw Operator				$14.67					$14.48	$17.33					$13.99	
1399	Concrete/Gunite Pump Operator																
1344	Crane Operator, Hydraulic 80 tons or less				$18.22		$18.36			$18.12	$18.04	$20.21			$18.63	$13.86	
1345	Crane Operator, Hydraulic Over 80 Tons																
1342	Crane Operator, Lattice Boom 80 Tons or Less	$16.82	$14.39	$13.85	$17.27		$15.87			$17.27		$14.67			$16.42	$14.97	$13.87
1343	Crane Operator, Lattice Boom Over 80 Tons				$20.52		$19.38			$20.52		$17.49			$25.13	$15.80	
1306	Crawler Tractor Operator	$13.96	$16.63	$13.62	$14.26		$15.67			$14.07	$13.15	$13.38			$14.60	$13.68	$13.50
1351	Crusher or Screen Plant Operator																
1446	Directional Drilling Locator						$11.67										
1445	Directional Drilling Operator				$20.32		$17.24										
1139	Electrician	$20.96		$19.87	$19.80		$26.35		$20.27	$19.80		$20.92				$27.11	$19.87
1347	Excavator Operator, 50,000 pounds or less	$13.46	$12.56	$13.67	$17.19		$12.88	$14.38	$13.49	$17.19		$13.88			$14.09	$12.71	$14.42
1348	Excavator Operator, Over 50,000 pounds		$15.23	$13.52	$17.04		$17.71			$16.99	$18.80	$16.22				$14.53	$13.52
1150	Flagger	$9.30	$9.10	$8.50	$10.28	$8.81	$9.45	$8.70		$10.06	$9.71	$9.03	$8.81	$9.08	$9.90	$10.33	$8.10
1151	Form Builder/Setter, Structures	$13.52	$12.30	$13.38	$12.91	$12.71	$12.87	$12.38	$12.26	$13.84	$12.98	$13.07	$13.61	$12.82	$14.73	$12.23	$12.25
1160	Form Setter, Paving & Curb	$12.36	$12.16	$13.93	$11.83	$10.71	$12.94			$13.16	$12.54	$11.33	$10.69		$13.33	$12.34	$13.93
1360	Foundation Drill Operator, Crawler Mounted				$17.99					$17.99						$17.43	
1363	Foundation Drill Operator, Truck Mounted		$16.86	$22.05	$21.51		$16.93			$21.07	$20.20	$20.76		$17.54	$21.39	$15.89	$22.05
1369	Front End Loader Operator, 3 CY or Less	$12.28	$13.49	$13.40	$13.85		$13.04	$13.15	$13.29	$13.69	$12.64	$12.89			$13.51	$13.32	$12.17
1372	Front End Loader Operator, Over 3 CY	$12.77	$13.69	$12.33	$14.96		$13.21	$12.86	$13.57	$14.72	$13.75	$12.32			$13.19	$13.17	$13.02
1329	Joint Sealer																
1172	Laborer, Common	$10.30	$9.86	$10.08	$10.51	$10.71	$10.50	$10.24	$10.58	$10.72	$10.45	$10.30	$10.25	$10.03	$10.54	$11.02	$10.15
1175	Laborer, Utility	$11.80	$11.53	$12.70	$12.17	$11.81	$12.27	$12.11	$11.33	$12.32	$11.80	$11.53	$11.23	$11.50	$11.95	$11.73	$12.37
1346	Loader/Backhoe Operator	$14.18	$12.77	$12.97	$15.68		$14.12			$15.18	$13.58	$12.87		$13.21	$14.13	$14.29	$12.90
1187	Mechanic	$20.14	$15.47	$17.47	$17.74	$17.00	$17.10			$17.68	$18.94	$18.58	$17.00	$16.61	$18.46	$16.96	$17.47
1380	Milling Machine Operator	$15.54	$14.64	$12.22	$14.29		$14.18			$14.32	$14.35	$12.86			$14.75	$13.53	$12.80

CLASS. #	CLASSIFICATION DESCRIPTION	ZONE TX02 *(TX20230002)	ZONE TX03 *(TX20230003)	ZONE TX04 *(TX20230004)	ZONE TX05 *(TX20230005)	ZONE TX06 *(TX20230006)	ZONE TX07 *(TX20230007)	ZONE TX08 *(TX20230008)	ZONE TX24 *(TX20230024)	ZONE TX25 *(TX20230025)	ZONE TX27 *(TX20230027)	ZONE TX28 *(TX20230028)	ZONE TX29 *(TX20230029)	ZONE TX30 *(TX20230030)	ZONE TX37 *(TX20230037)	ZONE TX38 *(TX20230038)	ZONE TX42 *(TX20230042)
1390	Motor Grader Operator, Fine Grade	$17.49	$16.52	$16.88	$17.12	$18.37	$18.51	$16.69	$16.13	$17.19	$18.35	$17.07	$17.74	$17.47	$17.08	$15.69	$20.01
1393	Motor Grader Operator, Rough	$16.15	$14.62	$15.83	$16.20	$17.07	$14.63	$18.50		$16.02	$16.44	$15.12	$16.85	$14.47	$17.39	$14.23	$15.53
1413	Off Road Hauler			$10.08	$12.26		$11.88			$12.25		$12.23			$13.00	$14.60	
1196	Painter, Structures					$21.29	$18.34						$21.29			$18.62	
1396	Pavement Marking Machine Operator	$16.42		$13.10	$13.55		$19.17	$12.01		$13.63	$14.60	$13.17		$16.65	$10.54	$11.18	$13.10
1443	Percussion or Rotary Drill Operator																
1202	Piledriver															$14.95	
1205	Pipelayer		$11.87	$14.64	$13.17	$11.17	$12.79		$11.37	$13.24	$12.66	$13.24	$11.17	$11.67		$12.12	$14.64
1384	Reclaimer/Pulverizer Operator	$12.85			$11.90		$12.88			$11.01		$10.46					
1500	Reinforcing Steel Worker	$13.50	$14.07	$17.53	$16.17		$14.00			$16.18	$12.74	$15.83		$17.10		$15.15	$17.72
1402	Roller Operator, Asphalt	$10.95		$11.96	$13.29		$12.78	$11.61		$13.08	$12.36	$11.68			$11.71	$11.95	$11.50
1405	Roller Operator, Other	$10.36		$10.44	$11.82		$10.50	$11.64		$11.51	$10.59	$10.30		$12.04	$12.85	$11.57	$10.66
1411	Scraper Operator	$10.61	$11.07	$10.85	$12.88		$12.27		$11.12	$12.96	$11.88	$12.43		$11.22	$13.95	$13.47	$10.89
1417	Self-Propelled Hammer Operator																
1194	Servicer	$13.98	$12.34	$14.11	$14.74		$14.51	$15.56	$13.44	$14.58	$14.31	$13.83		$12.43	$13.72	$13.97	$14.11
1513	Sign Erector																
1708	Slurry Seal or Micro-Surfacing Machine Operator																
1341	Small Slipform Machine Operator									$15.96							
1515	Spreader Box Operator	$12.60		$13.12	$14.71		$14.04			$14.73	$13.84	$13.68		$13.45	$11.83	$13.58	$14.05
1705	Structural Steel Welder															$12.85	
1509	Structural Steel Worker						$19.29									$14.39	
1339	Subgrade Trimmer																
1143	Telecommunication Technician																
1145	Traffic Signal/Light Pole Worker						$16.00										
1440	Trenching Machine Operator, Heavy						$18.48										
1437	Trenching Machine Operator, Light																
1609	Truck Driver Lowboy-Float	$14.46	$13.63	$13.41	$15.00	$15.93	$15.66			$16.24	$16.39	$14.30	$16.62	$15.63	$14.28	$16.03	$13.41
1612	Truck Driver Transit-Mix				$14.14					$14.14							
1600	Truck Driver, Single Axle	$12.74	$10.82	$10.75	$13.04	$11.61	$11.79	$13.53	$13.16	$12.31	$13.40	$10.30	$11.61		$11.97	$11.46	$10.75
1606	Truck Driver, Single or Tandem Axle Dump Truck	$11.33	$14.53	$11.95	$12.95		$11.68		$14.06	$12.62	$11.45	$12.28		$13.08	$11.68	$11.48	$11.10
1607	Truck Driver, Tandem Axle Tractor with Semi Trailer	$12.49	$12.12	$12.50	$13.42		$12.81	$13.16		$12.86	$16.22	$12.50			$13.80	$12.27	$12.50
1441	Tunneling Machine Operator, Heavy																
1442	Tunneling Machine Operator, Light																
1706	Welder		$14.02		$14.86		$15.97		$13.74	$14.84					$13.78		
1520	Work Zone Barricade Servicer	$10.30	$12.88	$11.46	$11.70	$11.57	$11.85	$10.77		$11.68	$12.20	$11.22	$11.51	$12.96	$10.54	$11.67	$11.76

Notes:

*Represents the USDOL wage decision.

Any worker employed on this project shall be paid at the rate of one and one half (1-1/2) times the regular rate for every hour worked in excess of forty (40) hours per week.

For reference, the titles and descriptions for the classifications listed here are detailed further in the AGC of Texas' *Standard Job Classifications and Descriptions for Highway, Heavy, Utilities, and Industrial Construction in Texas* posted on the AGC's Web site for any contractor.

TEXAS COUNTIES IDENTIFIED BY
WAGE RATE ZONES: 2, 3, 4, 5, 6, 7, 8, 24, 25, 27, 28, 29, 30, 37, 38, 42

County Name	Zone	County Name	Zone	County Name	Zone	County Name	Zone
Anderson	28	Donley	37	Karnes	27	Reagan	37
Andrews	37	Duval	30	Kaufman	25	Real	37
Angelina	28	Eastland	37	Kendall	7	Red River	28
Aransas	29	Ector	2	Kenedy	30	Reeves	8
Archer	25	Edwards	8	Kent	37	Refugio	27
Armstrong	2	El Paso	24	Kerr	27	Roberts	37
Atascosa	7	Ellis	25	Kimble	37	Robertson	7
Austin	38	Erath	28	King	37	Rockwall	25
Bailey	37	Falls	28	Kinney	8	Runnels	37
Bandera	7	Fannin	28	Kleberg	27	Rusk	4
Bastrop	7	Fayette	27	Knox	37	Sabine	28
Baylor	37	Fisher	37	Lamar	28	San Augustine	28
Bee	27	Floyd	37	Lamb	37	San Jacinto	38
Bell	7	Foard	37	Lampasas	7	San Patricio	29
Bexar	7	Fort Bend	38	LaSalle	30	San Saba	37
Blanco	27	Franklin	28	Lavaca	27	Schleicher	37
Borden	37	Freestone	28	Lee	27	Scurry	37
Bosque	28	Frio	27	Leon	28	Shackelford	37
Bowie	4	Gaines	37	Liberty	38	Shelby	28
Brazoria	38	Galveston	38	Limestone	28	Sherman	37
Brazos	7	Garza	37	Lipscomb	37	Smith	4
Brewster	8	Gillespie	27	Live Oak	27	Somervell	28
Briscoe	37	Glasscock	37	Llano	27	Starr	30
Brooks	30	Goliad	29	Loving	37	Stephens	37
Brown	37	Gonzales	27	Lubbock	2	Sterling	37
Burleson	7	Gray	37	Lynn	37	Stonewall	37
Burnet	27	Grayson	25	Madison	28	Sutton	8
Caldwell	7	Gregg	4	Marion	28	Swisher	37
Calhoun	29	Grimes	28	Martin	37	Tarrant	25
Callahan	25	Guadalupe	7	Mason	27	Taylor	2
Cameron	3	Hale	37	Matagorda	27	Terrell	8
Camp	28	Hall	37	Maverick	30	Terry	37
Carson	2	Hamilton	28	McCulloch	37	Throckmorton	37
Cass	28	Hansford	37	McLennan	7	Titus	28
Castro	37	Hardeman	37	McMullen	30	Tom Green	2
Chambers	38	Hardin	38	Medina	7	Travis	7
Cherokee	28	Harris	38	Menard	37	Trinity	28
Childress	37	Harrison	42	Midland	2	Tyler	28
Clay	25	Hartley	37	Milam	28	Upshur	4
Cochran	37	Haskell	37	Mills	37	Upton	37
Coke	37	Hays	7	Mitchell	37	Uvalde	30
Coleman	37	Hemphill	37	Montague	37	Val Verde	8
Collin	25	Henderson	28	Montgomery	38	Van Zandt	28
Collingsworth	37	Hidalgo	3	Moore	37	Victoria	6
Colorado	27	Hill	28	Morris	28	Walker	28
Comal	7	Hockley	37	Motley	37	Waller	38
Comanche	37	Hood	28	Nacogdoches	28	Ward	37
Concho	37	Hopkins	28	Navarro	28	Washington	28
Cooke	37	Houston	28	Newton	28	Webb	3
Coryell	7	Howard	37	Nolan	37	Wharton	27
Cottle	37	Hudspeth	8	Nueces	29	Wheeler	37
Crane	37	Hunt	25	Ochiltree	37	Wichita	5
Crockett	8	Hutchinson	37	Oldham	37	Wilbarger	37
Crosby	2	Irion	2	Orange	38	Willacy	30
Culberson	8	Jack	28	Palo Pinto	28	Williamson	7
Dallam	37	Jackson	27	Panola	28	Wilson	7
Dallas	25	Jasper	28	Parker	25	Winkler	37
Dawson	37	Jeff Davis	8	Parmer	37	Wise	25
Deaf Smith	37	Jefferson	38	Pecos	8	Wood	28
Delta	25	Jim Hogg	30	Polk	28	Yoakum	37
Denton	25	Jim Wells	27	Potter	2	Young	37
DeWitt	27	Johnson	25	Presidio	8	Zapata	30
Dickens	37	Jones	25	Rains	28	Zavala	30
Dimmit	30			Randall	2		

01/06/2023

Special Provision to Item 000
Nondiscrimination

1. DESCRIPTION

All recipients of federal financial assistance are required to comply with various nondiscrimination laws including Title VI of the Civil Rights Act of 1964, as amended, (Title VI). Title VI forbids discrimination against anyone in the United States on the grounds of race, color, or national origin by any agency receiving federal funds.

Texas Department of Transportation, as a recipient of Federal financial assistance, and under Title VI and related statutes, ensures that no person shall on the grounds of race, religion (where the primary objective of the financial assistance is to provide employment per 42 U.S.C. § 2000d-3), color, national origin, sex, age or disability be excluded from participation in, be denied the benefits of, or otherwise be subjected to discrimination under any Department programs or activities.

2. DEFINITION OF TERMS

Where the term “contractor” appears in the following six nondiscrimination clauses, the term “contractor” is understood to include all parties to contracts or agreements with the Texas Department of Transportation.

3. NONDISCRIMINATION PROVISIONS

During the performance of this contract, the contractor agrees as follows:

3.1. **Compliance with Regulations**. The Contractor shall comply with the Regulations relative to nondiscrimination in Federally-assisted programs of the Department of Transportation (hereinafter, “DOT”) Title 49, Code of Federal Regulations, Part 21, as they may be amended from time to time, (hereinafter referred to as the Regulations), which are herein incorporated by reference and made a part of this contract.

3.2. **Nondiscrimination**. The contractor, with regard to the work performed by it during the contract, shall not discriminate on the grounds of race, color, or national origin in the selection and retention of subcontractors, including procurements of materials and leases of equipment. The contractor shall not participate either directly or indirectly in the discrimination prohibited by section 21.5 of the Regulations, including employment practices when the contract covers a program set forth in Appendix B of the Regulations.

3.3. **Solicitations for Subcontracts, Including Procurements of Materials and Equipment:** In all solicitations either by competitive bidding or negotiation made by the contractor for work to be performed under a subcontract, including procurements of materials or leases of equipment, each potential subcontractor or supplier shall be notified by the contractor of the contractor's obligations under this contract and the Regulations relative to nondiscrimination on the grounds of race, color, or national origin.

3.4. **Information and Reports:** The contractor shall provide all information and reports required by the Regulations or directives issued pursuant thereto, and shall permit access to its books, records, accounts, other sources of information, and its facilities as may be determined by the Recipient or the Texas Department of Transportation to be pertinent to ascertain compliance with such Regulations, orders and instructions. Where any information required of a contractor is in the exclusive possession of another who fails or refuses to furnish this information the contractor shall so certify to the Recipient, or the Texas Department of Transportation as appropriate, and shall set forth what efforts it has made to obtain the information.

3.5. **Sanctions for Noncompliance**. In the event of the contractor's noncompliance with the nondiscrimination provisions of this contract, the Recipient shall impose such contract sanctions as it or the Texas Department of Transportation may determine to be appropriate, including, but not limited to:

- withholding of payments to the contractor under the contract until the contractor complies, and/or
- cancellation, termination or suspension of the contract, in whole or in part.

3.6. **Incorporation of Provisions**. The contractor shall include the provisions of paragraphs (1) through (6) in every subcontract, including procurements of materials and leases of equipment, unless exempt by the Regulations, or directives issued pursuant thereto. The contractor shall take such action with respect to any subcontract or procurement as the Recipient or the Texas Department of Transportation may direct as a means of enforcing such provisions including sanctions for non-compliance: Provided, however, that, in the event a contractor becomes involved in, or is threatened with, litigation with a subcontractor or supplier as a result of such direction, the contractor may request the Recipient to enter into such litigation to protect the interests of the Recipient, and, in addition, the contractor may request the United States to enter into such litigation to protect the interests of the United States.

Special Provision to Item 000
Certification of Nondiscrimination in Employment

1. GENERAL

By signing this proposal, the Bidder certifies that he has participated in a previous contract or subcontract subject to the equal opportunity clause, as required by Executive Orders 10925, 11114, or 11246, or if he has not participated in a previous contract of this type, or if he has had previous contract or subcontracts and has not filed, he will file with the Joint Reporting Committee, the Director of the Office of Federal Contract Compliance, a Federal Government contracting or administering agency, or the former President's Committee on Equal Employment Opportunity, all reports due under the applicable filing requirements.

Note—The above certification is required by the Equal Employment Opportunity Regulations of the Secretary of Labor (41 CFR 60-1.7(b)(1)), and must be submitted by Bidders and proposed subcontractors only in connection with contracts and subcontracts which are subject to the equal opportunity clause. Contracts and subcontracts which are exempt from the equal opportunity clause are set forth in 41 CFR 60-1.5. (Generally only contracts or subcontracts of $10,000 or under are exempt.)

Currently, Standard Form 100 (EEO-1) is the only report required by the Executive Orders or their implementing regulations.

Proposed prime contractors and subcontractors who have participated in a previous contract or subcontract subject to the Executive Orders and have not filed the required reports should note that 41 CFR 60-1.7(b)(1) prevents the award of contracts and subcontracts unless such contractor submits a report covering the delinquent period or such other period specified by the Federal Highway Administration or by the Director, Office of Federal Contract Compliance, U.S. Department of Labor.

Special Provision to Item 000

Notice of Requirement for Affirmative Action to Ensure Equal Employment Opportunity (Executive Order 11246)

1. GENERAL

In addition to the affirmative action requirements of the Special Provision titled "Standard Federal Equal Employment Opportunity Construction Contract Specifications" as set forth elsewhere in this proposal, the Bidder's attention is directed to the specific requirements for utilization of minorities and females as set forth below.

2. GOALS

2.1. Goals for minority and female participation are hereby established in accordance with 41 CFR 60-4.

2.2. The goals for minority and female participation expressed in percentage terms for the Contractor's aggregate work force in each trade on all construction work in the covered area are as follows:

Goals for minority participation in each trade, %	Goals for female participation in each trade, %
See Table 1	6.9

2.3. These goals are applicable to all the Contractor's construction work (whether or not it is Federal or federally assisted) performed in the covered area. If the Contractor performs construction work in a geographical area located outside of the covered area, it will apply the goals established for such geographical area where the work is actually performed. With regard to this second area, the Contractor also is subject to the goals for both its federally involved and non-federally involved construction. The Contractor's compliance with the Executive Order and the regulations in 41 CFR Part 60-4 will be based on its implementation of the Standard Federal Equal Employment Opportunity Construction Contract Specifications Special Provision and its efforts to meet the goals. The hours of minority and female employment and training must be substantially uniform throughout the length of the Contract, and in each trade, and the Contractor must make a good faith effort to employ minorities and women evenly on each of its projects. The transfer of minority and female employees or trainees from Contractor to Contractor or from project to project for the sole purpose of meeting the Contractor's goals will be a violation of the Contract, the Executive Order and the regulations in 41 CFR Part 60-4. Compliance with the goals will be measured against the total work hours performed.

2.4. A Contractor or subcontractor will be considered in compliance with these provisions by participation in the Texas Highway-Heavy Branch, AGC, Statewide Training and Affirmative Action Plan. Provided that each Contractor or subcontractor participating in this plan must individually comply with the equal opportunity clause set forth in 41 CFR 60-1.4 and must make a good faith effort to achieve the goals set forth for each participating trade in the plan in which it has employees. The overall good performance of other Contractors and subcontractors toward a goal in an approved plan does not excuse any covered Contractor's or subcontractor's failure to make good faith efforts to achieve the goals contained in these provisions. Contractors or subcontractors participating in the plan must be able to demonstrate their participation and document their compliance with the provisions of this Plan.

3. SUBCONTRACTING

The Contractor must provide written notification to the Department within 10 working days of award of any construction subcontract in excess of $10,000 at any tier for construction work under the Contract resulting from this solicitation pending concurrence of the Department in the award. The notification will list the names,

address and telephone number of the subcontractor; employer identification number; estimated dollar amount of the subcontract; estimated starting and completion dates of the subcontract; and the geographical area in which the Contract is to be performed.

4. COVERED AREA

As used in this special provision, and in the Contract resulting from this solicitation, the geographical area covered by these goals for female participation is the State of Texas. The geographical area covered by these goals for other minorities are the counties in the State of Texas as indicated in Table 1.

5. REPORTS

The Contractor is hereby notified that he may be subject to the Office of Federal Contract Compliance Programs (OFCCP) reporting and record keeping requirements as provided for under Executive Order 11246 as amended. OFCCP will provide direct notice to the Contractor as to the specific reporting requirements that he will be expected to fulfill.

Table 1
Goals for Minority Participation

County	Participation, %	County	Participation, %
Anderson	22.5	Chambers	27.4
Andrews	18.9	Cherokee	22.5
Angelina	22.5	Childress	11.0
Aransas	44.2	Clay	12.4
Archer	11.0	Cochran	19.5
Armstrong	11.0	Coke	20.0
Atascosa	49.4	Coleman	10.9
Austin	27.4	Collin	18.2
Bailey	19.5	Collingsworth	11.0
Bandera	49.4	Colorado	27.4
Bastrop	24.2	Comal	47.8
Baylor	11.0	Comanche	10.9
Bee	44.2	Concho	20.0
Bell	16.4	Cooke	17.2
Bexar	47.8	Coryell	16.4
Blanco	24.2	Cottle	11.0
Borden	19.5	Crane	18.9
Bosque	18.6	Crockett	20.0
Bowie	19.7	Crosby	19.5
Brazoria	27.3	Culberson	49.0
Brazos	23.7	Dallam	11.0
Brewster	49.0	Dallas	18.2
Briscoe	11.0	Dawson	19.5
Brooks	44.2	Deaf Smith	11.0
Brown	10.9	Delta	17.2
Burleson	27.4	Denton	18.2
Burnet	24.2	DeWitt	27.4
Caldwell	24.2	Dickens	19.5
Calhoun	27.4	Dimmit	49.4
Callahan	11.6	Donley	11.0
Cameron	71.0	Duval	44.2
Camp	20.2	Eastland	10.9
Carson	11.0	Ector	15.1
Cass	20.2	Edwards	49.4
Castro	11.0	Ellis	18.2

County	Participation, %	County	Participation, %
El Paso	57.8	Kenedy	44.2
Erath	17.2	Kent	10.9
Falls	18.6	Kerr	49.4
Fannin	17.2	Kimble	20.0
Fayette	27.4	King	19.5
Fisher	10.9	Kinney	49.4
Floyd	19.5	Kleberg	44.2
Foard	11.0	Knox	10.9
Fort Bend	27.3	Lamar	20.2
Franklin	17.2	Lamb	19.5
Freestone	18.6	Lampasas	18.6
Frio	49.4	LaSalle	49.4
Gaines	19.5	Lavaca	27.4
Galveston	28.9	Lee	24.2
Garza	19.5	Leon	27.4
Gillespie	49.4	Liberty	27.3
Glasscock	18.9	Limestone	18.6
Goliad	27.4	Lipscomb	11.0
Gonzales	49.4	Live Oak	44.2
Gray	11.0	Llano	24.2
Grayson	9.4	Loving	18.9
Gregg	22.8	Lubbock	19.6
Grimes	27.4	Lynn	19.5
Guadalupe	47.8	Madison	27.4
Hale	19.5	Marion	22.5
Hall	11.0	Martin	18.9
Hamilton	18.6	Mason	20.0
Hansford	11.0	Matagorda	27.4
Hardeman	11.0	Maverick	49.4
Hardin	22.6	McCulloch	20.0
Harris	27.3	McLennan	20.7
Harrison	22.8	McMullen	49.4
Hartley	11.0	Medina	49.4
Haskell	10.9	Menard	20.0
Hays	24.1	Midland	19.1
Hemphill	11.0	Milam	18.6
Henderson	22.5	Mills	18.6
Hidalgo	72.8	Mitchell	10.9
Hill	18.6	Montague	17.2
Hockley	19.5	Montgomery	27.3
Hood	18.2	Moore	11.0
Hopkins	17.2	Morris	20.2
Houston	22.5	Motley	19.5
Howard	18.9	Nacogdoches	22.5
Hudspeth	49.0	Navarro	17.2
Hunt	17.2	Newton	22.6
Hutchinson	11.0	Nolan	10.9
Irion	20.0	Nueces	41.7
Jack	17.2	Ochiltree	11.0
Jackson	27.4	Oldham	11.0
Jasper	22.6	Orange	22.6
Jeff Davis	49.0	Palo Pinto	17.2
Jefferson	22.6	Panola	22.5
Jim Hogg	49.4	Parker	18.2
Jim Wells	44.2	Parmer	11.0
Johnson	18.2	Pecos	18.9
Jones	11.6	Polk	27.4
Karnes	49.4	Potter	9.3
Kaufman	18.2	Presidio	49.0
Kendall	49.4	Randall	9.3

County	Participation, %	County	Participation, %
Rains	17.2	Reagan	20.0
Real	49.4	Throckmorton	10.9
Red River	20.2	Titus	20.2
Reeves	18.9	Tom Green	19.2
Refugio	44.2	Travis	24.1
Roberts	11.0	Trinity	27.4
Robertson	27.4	Tyler	22.6
Rockwall	18.2	Upshur	22.5
Runnels	20.0	Upton	18.9
Rusk	22.5	Uvalde	49.4
Sabine	22.6	Val Verde	49.4
San Augustine	22.5	Van Zandt	17.2
San Jacinto	27.4	Victoria	27.4
San Patricio	41.7	Walker	27.4
San Saba	20.0	Waller	27.3
Schleicher	20.0	Ward	18.9
Scurry	10.9	Washington	27.4
Shackelford	10.9	Webb	87.3
Shelby	22.5	Wharton	27.4
Sherman	11.0	Wheeler	11.0
Smith	23.5	Wichita	12.4
Somervell	17.2	Wilbarger	11.0
Starr	72.9	Willacy	72.9
Stephens	10.9	Williamson	24.1
Sterling	20.0	Wilson	49.4
Stonewall	10.9	Winkler	18.9
Sutton	20.0	Wise	18.2
Swisher	11.0	Wood	22.5
Tarrant	18.2	Yoakum	19.5
Taylor	11.6	Young	11.0
Terrell	20.0	Zapata	49.4
Terry	19.5	Zavala	49.4

Special Provision to Item 000

Standard Federal Equal Employment Opportunity Construction Contract Specifications (Executive Order 11246)

1. GENERAL

1.1. As used in these specifications:

- "Covered area" means the geographical area described in the solicitation from which this Contract resulted;
- "Director" means Director, Office of Federal Contract Compliance Programs, United States Department of Labor, or any person to whom the Director delegates authority;
- "Employer identification number" means the Federal Social Security number used on the Employer's Quarterly Federal Tax Return, U.S. Treasury Department Form 941.
- "Minority" includes:
  - Black (all persons having origins in any of the Black African racial groups not of Hispanic origin);
  - Hispanic (all persons of Mexican, Puerto Rican, Cuban, Central or South American or other Spanish Culture or origin, regardless of race);
  - Asian and Pacific Islander (all persons having origins in any of the original peoples of the Far East, Southeast Asia, the Indian Subcontinent, or the Pacific Islands); and
  - American Indian or Alaskan Native (all persons having origins in any of the original peoples of North American and maintaining identifiable tribal affiliations through membership and participation or community identification).

1.2. Whenever the Contractor, or any Subcontractor at any tier, subcontracts a portion of the work involving any construction trade, it will physically include in each subcontract in excess of $10,000 the provisions of these specifications and the Notice which contains the applicable goals for minority and female participation and which is set forth in the solicitations from which this Contract resulted.

1.3. If the Contractor is participating (pursuant to 41 CFR 60-4.5) in a Hometown Plan approved by the U. S. Department of Labor in the covered area either individually or through an association, its affirmative action obligations on all work in the Plan area (including goals and timetables) will be in accordance with that plan for those trades which have unions participating in the Plan. Contractors must be able to demonstrate their participation in and compliance with the provisions of any such Hometown Plan. Each Contractor or Subcontractor participating in an approved Plan is individually required to comply with its obligations under the equal employment opportunity (EEO) clause, and to make a good faith effort to achieve each goal under the Plan in each trade in which it has employees. The overall good faith performance by other Contractors or Subcontractors toward a goal in an approved Plan does not excuse any covered Contractor's or Subcontractor's failure to take good faith efforts to achieve the Plan goals and timetables.

1.4. The Contractor will implement the specific affirmative action standards provided in Section 1.7.1. through Section 1.7.16. of these specifications. The goals set forth in the solicitation from which this Contract resulted are expressed as percentages of the total hours of employment and training of minority and female utilization the Contractor should reasonably be able to achieve in each construction trade in which it has employees in the covered area. Covered construction Contractors performing Contracts in geographical areas where they do not have a Federal or federally assisted construction Contract will apply the minority and female goals established for the geographical area where the Contract is being performed. Goals are published periodically in the Federal Register in notice form and such notices may be obtained from any Office of Federal Contract Compliance Programs office or any Federal procurement contracting officer. The

Contractor is expected to make substantially uniform progress toward its goals in each craft during the period specified.

1.5. Neither the provisions of any collective bargaining agreement, nor the failure by a union with whom the Contractor has a collective bargaining agreement, to refer either minorities or women will excuse the Contractor's obligations under these specifications, Executive Order 11246, or the regulations promulgated pursuant thereto.

1.6. In order for the nonworking training hours of apprentices and trainees to be counted in meeting the goals, such apprentices and trainees must be employed by the Contractor during the training period, and the Contractor must have made a commitment to employ the apprentices and trainees at the completion of their training, subject to the availability of employment opportunities. Trainees must be trained pursuant to training programs approved by the U. S. Department of Labor.

1.7. The Contractor will take specific affirmative actions to ensure equal employment opportunity. The evaluation of the Contractor's compliance with these specifications will be based upon its effort to achieve maximum results from its actions. The Contractor will document these efforts fully, and will implement affirmative action steps at least as extensive as the following:

1.7.1. Ensure and maintain a working environment free of harassment, intimidation, and coercion at all sites, and in all facilities at which the Contractor's employees are assigned to work. The Contractor, where possible, will assign two or more women to each construction project. The Contractor will specifically ensure that all foremen, superintendents, and other on-site supervisory personnel are aware of and carry out the Contractor's obligation to maintain such a working environment, with specific attention to minority or female individuals working at such sites or in such facilities.

1.7.2. Establish and maintain a current list of minority and female recruitment sources, provide written notification to minority and female recruitment sources and to community organizations when the Contractor or its unions have employment opportunities available, and maintain a record of the organizations' responses.

1.7.3. Maintain a current file of the names, addresses and telephone numbers of each minority and female off-the-street applicant and minority or female referral from a union, a recruitment source or community organization and of what action was taken with respect to each such individual. If such individual was sent to the union hiring hall for referral and was not referred back to the Contractor by the union or, if referred, not employed by the Contractor, this will be documented in the file with the reason therefor, along with whatever additional actions the Contractor may have taken.

1.7.4. Provide immediate written notification to the Director when the union or unions with which the Contractor has a collective bargaining agreement has not referred to the Contractor a minority person or woman sent by the Contractor, or when the Contractor has other information that the union referral Process has impeded the Contractor's efforts to meet its obligations.

1.7.5. Develop on-the-job training opportunities and/or participate in training programs for the area which expressly include minorities and women, including upgrading programs and apprenticeship and trainee programs relevant to the Contractor's employment needs, especially those programs funded or approved by the Department of Labor. The Contractor will provide notice of these programs to the sources compiled under 7b above.

1.7.6. Disseminate the Contractor's EEO policy by providing notice of the policy to unions and training programs and requesting their cooperation in assisting the Contractor in meeting its EEO obligations; by including it in any policy manual and Collective bargaining agreement; by publicizing it in the company newspaper, annual report, etc.; by specific review of the policy with all management personnel and with all minority and female employees at least once a year; and by posting the company EEO policy on bulletin boards accessible to all employees at each location where construction work is performed.

1.7.7. Review, at least annually, the company's EEO policy and affirmative action obligations under these specifications with all employees having any responsibility for hiring, assignment, layoff, termination or other

employment decisions including specific review of these items with on-site supervisory personnel such as Superintendents, General Foremen, etc., before the initiation of construction work at any job site. A written record must be made and maintained identifying the time and place of these meetings, persons attending, subject matter discussed, and disposition of the subject matter.

1.7.8. Disseminate the Contractor's EEO policy externally by including it in any advertising in the news media, specifically including minority and female news media, and providing written notification to and discussing the Contractor's EEO policy with other Contractors and Subcontractors with whom the Contractor does or anticipates doing business.

1.7.9. Direct its recruitment efforts, both oral and written, to minority, female and community organizations, to schools with minority and female students and to minority and female recruitment and training organizations serving the Contractor's recruitment area and employment needs. Not later than one month before the date for the acceptance of applications for apprenticeship or other training by any recruitment source, the Contractor will send written notification to organizations such as the above, describing the openings, screening procedures, and tests to be used in the selection process.

1.7.10. Encourage present minority and female employees to recruit other minority persons and women and, where reasonable, provide after school, summer and vacation employment to minority and female youth both on the site and in other areas of a Contractor's workforce.

1.7.11. Validate all tests and other selection requirements where there is an obligation to do so under 41 CFR Part 60-3.

1.7.12. Conduct, at least annually, an inventory and evaluation at least of all minority and female personnel for promotional opportunities and encourage these employees to seek or to prepare for, through appropriate training, etc., such opportunities.

1.7.13. Ensure that seniority practices, job classifications, work assignments and other personnel practices, do not have a discriminatory effect by continually monitoring all personnel and employment-related activities to ensure that the EEO policy and the Contractor's obligations under these specifications are being carried out.

1.7.14. Ensure that all facilities and company activities are non-segregated except that separate or single-user toilet and necessary changing facilities will be provided to assure privacy between the sexes.

1.7.15. Document and maintain a record of all solicitations of offers for subcontracts from minority and female construction contractors and suppliers, including circulation of solicitations to minority and female contractor associations and other business associations.

1.7.16. Conduct a review, at least annually, of all supervisors' adherence to and performance under the Contractor's EEO policies and affirmative action obligations.

1.8. Contractors are encouraged to participate in voluntary associations which assist in fulfilling one or more of their affirmative action obligations (Section 7.1. through Section 7.16.). The efforts of a contractor association, joint contractor-union, contractor-community, or other similar group of which the Contractor is a member and participant, may be asserted as fulfilling any one or more of its obligations under Section 7.1. through Section 7.16. of these Specifications provided that the Contractor actively participates in the group, makes every effort to assure that the group has a positive impact on the employment of minorities and women in the industry, ensures that the concrete benefits of the program are reflected in the Contractor's minority and female workforce participation, makes a good faith effort to meet its individual goals and timetables, and can provide access to documentation which demonstrates the effectiveness of actions taken on behalf of the Contractor. The obligation to comply, however, is the Contractor's and failure of such a group to fulfill an obligation will not be a defense for the Contractor's noncompliance.

1.9. A single goal for minorities and a separate single goal for women have been established. The Contractor, however, is required to provide equal employment opportunity and to take affirmative action for all minority groups, both male and female, and all women, both minority and non-minority. Consequently, the Contractor

may be in violation of the Executive Order if a particular group is employed in a substantially disparate manner (for example, even though the Contractor has achieved its goals for women generally, the Contractor may be in violation of the Executive Order if a specific minority group of women is underutilized).

1.10. The Contractor shall not use the goals and timetables or affirmative action standards to discriminate against any person because of race, color, religion, sex, or national origin.

1.11. The Contractor will not enter into any Subcontract with any person or firm debarred from Government Contracts pursuant to Executive Order 11246.

1.12. The Contractor will carry out such sanctions and penalties for violation of these specifications and of the Equal Opportunity Clause, including suspension, termination and cancellation of existing subcontracts as may be imposed or ordered pursuant to Executive Order 11246, as amended, and its implementing regulations, by the Office of Federal Contract Compliance Programs. Any Contractor who fails to carry out such sanctions and penalties will be in violation of these specifications and Executive Order 11246, as amended.

1.13. The Contractor, in fulfilling its obligations under these specifications, will implement specific affirmative action steps, at least as extensive as those standards prescribed in paragraph 7 of these specifications, so as to achieve maximum results from its efforts to ensure equal employment opportunity. If the Contractor fails to comply with the requirements of the Executive Order, the implementing regulations, or these specifications, the Director will proceed in accordance with 41 CFR 60-4.8.

1.14. The Contractor will designate a responsible official to monitor all employment-related activity to ensure that the company EEO policy is being carried out, to submit reports relating to the provisions hereof as may be required by the Government and to keep records. Records must at least include for each employee the name, address, telephone numbers, construction trade, union affiliation if any, employee identification number when assigned, social security number, race, sex, status (e.g., mechanic, apprentice, trainee, helper, or laborer), dates of changes in status, hours worked per week in the indicated trade, rate of pay, and locations at which the work was performed. Records must be maintained in an easily understandable and retrievable form; however, to the degree that existing records satisfy this requirement, Contractors shall not be required to maintain separate records.

1.15. Nothing herein provided will be construed as a limitation upon the application of other laws which establish different standards of compliance or upon the application of requirements for the hiring of local or other area residents (e.g., those under the Public Works Employment Act of 1977 and the Community Development Block Grant Program).

1.16. In addition to the reporting requirements set forth elsewhere in this Contract, the Contractor and the subcontractors holding subcontracts, not including material suppliers, of $10,000 or more, will submit for every month of July during which work is performed, employment data as contained under Form PR 1391 (Appendix C to 23 CFR, Part 230), and in accordance with the included instructions.

Special Provision to Item 000
On-the-Job Training Program

1. DESCRIPTION

The primary objective of this Special Provision is the training and advancement of minorities, women and economically disadvantaged persons toward journeyworker status. Accordingly, make every effort to enroll minority, women and economically disadvantaged persons to the extent that such persons are available within a reasonable area of recruitment. This training commitment is not intended, and will not be used to discriminate against any applicant for training, whether or not he/she is a member of a minority group.

2. TRAINEE ASSIGNMENT

Training assignments are based on the past volume of state-let highway construction contracts awarded with the Department. Contractors meeting the selection criteria will be notified of their training assignment at the beginning of the reporting year by the Department's Office of Civil Rights.

3. PROGRAM REQUIREMENTS

Fulfill all of the requirements of the On-the-Job Training Program including the maintenance of records and submittal of periodic reports documenting program performance. Trainees will be paid at least 60% of the appropriate minimum journeyworker's rate specified in the Contract for the first half of the training period, 75% for the third quarter, and 90% for the last quarter, respectively.

4. REIMBURSEMENT

If requested, Contractors may be reimbursed $0.80 per training hour at no additional cost to the Department. Training may occur on this project, all other Department contracts, or local-administered federal-aid projects with concurrence of the local government entity. However, reimbursement for training is not available on projects to the extent that such projects that do not contain federal funds.

5. COMPLIANCE

The Contractor will have fulfilled the contractual responsibilities by having provided acceptable training to the number of trainees specified in their goal assignment. Noncompliance may be cause for corrective and appropriate measures pursuant to Article 8.7., "Abandonment of Work or Default of Contract," which may be used to comply with the sanctions for noncompliance pursuant to 23 CFR Part 230.

Special Provision 000
Certificate of Interested Parties (Form 1295)

Submit a notarized Form 1295, "Certificate of Interested Parties," in the following instances:

- at Contract execution for Contracts awarded by the Commission;
- at Contract execution for Contracts awarded by the District Engineer or Chief Engineer with an award amount of $1,000,000 or more; at any time an existing Contract awarded by the District Engineer or Chief Engineer increases in value to $1,000,000 or more due to changes in the Contract; at any time there is an increase of $1,000,000 or more to an existing Contract (change orders, extensions, and renewals); or
- at any time there is a change to the information in Form 1295, when the form was filed for an existing Contract.

Form 1295 and instructions on completing and filing the form are available on the Texas Ethics Commission website.

Special Provision 000
Important Notice to Contractors

For Dollar Amount of Original Contract		Dollar Amount of Daily Contract Administration Liquidated Damages per Working Day
From More Than	To and including	
0	1,000,000	618
1,000,000	3,000,000	832
3,000,000	5,000,000	940
5,000,000	15,000,000	1317
15,000,000	25,000,000	1718
25,000,000	50,000,000	2411
50,000,000	Over 50,000,000	4265

In addition to the amount shown in Table 1, the Liquidated Damages will be increased by the amount shown in Item 8 of the General Notes for Road User Cost (RUC), when applicable.

Special Provision 000

Cargo Preference Act Requirements in Federal Aid Contracts

1. DESCRIPTION

All recipients of federal financial assistance are required to comply with the U.S. Department of Transportation's (DOT) Cargo Preference Act Requirements, 46 CFR Part 381, Use of United States-Flag Vessels.

This requirement applies to material or equipment that is acquired specifically for a Federal-aid highway project. It is not applicable to goods or materials that come into inventories independent of a Federal Highway Administration (FHWA) funded contract.

When oceanic shipments are necessary for materials or equipment acquired for a specific Federal-aid construction project, the contractor agrees to:

- Utilize privately owned United States-flag commercial vessels to ship at least 50 percent of the gross tonnage (computed separately for dry bulk carriers, dry cargo liners, and tankers) involved, whenever shipping any equipment, material, or commodities pursuant to this contract, to the extent such vessels are available at fair and reasonable rates for United States-flag commercial vessels.

- Furnish a legible copy of a rated, on-board commercial ocean bill-of-lading in English for each shipment of cargo described in paragraph (b) (1) of 46 CFR Part 381 Section 7, "Federal Grant, Guaranty, Loan and Advance of Funds Agreements," within 20 days following the date of loading for shipments originating within the United States or within 30 working days following the date of loading for shipments originating outside the United States, to both the Engineer (through the prime contractor in the case of subcontractor bills-of-lading) and to the Division of National Cargo, Office of Market Development, Maritime Administration, Washington, DC 20590.

- Insert the substance of the provisions of this clause in all subcontracts issued pursuant to this contract.

Special Provision to Item 000

Disadvantaged Business Enterprise in Federal-Aid Contracts

1. DESCRIPTION

The purpose of this Special Provision is to carry out the U.S. Department of Transportation's (DOT) policy of ensuring nondiscrimination in the award and administration of DOT-assisted Contracts and creating a level playing field on which firms owned and controlled by individuals who are determined to be socially and economically disadvantaged can compete fairly for DOT-assisted Contracts.

2. DISADVANTAGED BUSINESS ENTERPRISE IN FEDERAL-AID CONTRACTS

2.1. **Policy.** It is the policy of the DOT and the Texas Department of Transportation (Department) that DBEs, as defined in 49 CFR Part 26, Subpart A, and the Department's DBE Program, will have the opportunity to participate in the performance of Contracts financed in whole or in part with federal funds. The DBE requirements of 49 CFR Part 26, and the Department's DBE Program, apply to this Contract as follows.

The Contractor will solicit DBEs through reasonable and available means, as defined in 49 CFR Part 26, Appendix A, and the Department's DBE Program, or show a good faith effort to meet the DBE goal for this Contract.

The Contractor, subrecipient, or subcontractor will not discriminate on the basis of race, color, national origin, or sex in the performance of this Contract. Carry out applicable requirements of 49 CFR Part 26 in the award and administration of DOT-assisted Contracts. Failure to carry out these requirements is a material breach of this Contract, which may result in the termination of this Contract or such other remedy as the Department deems appropriate.

The requirements of this Special Provision must be physically included in any subcontract.

By signing the Contract proposal, the Bidder is certifying that the DBE goal as stated in the proposal will be met by obtaining commitments from eligible DBEs or that the Bidder will provide acceptable evidence of good faith effort to meet the commitment.

2.2. **Definitions.**

2.2.1. **Administrative Reconsideration.** A process by which the low bidder may request reconsideration when the Department determines the good faith effort (GFE) requirements have not been met.

2.2.2. **Commercially Useful Function (CUF).** A CUF occurs when a DBE has the responsibility for the execution of the work and carrying out such responsibilities by actually performing, managing, and supervising the work.

2.2.3. **Disadvantaged Business Enterprise (DBE).** A for-profit small business certified through the Texas Unified Certification Program in accordance with 49 CFR Part 26, that is at least 51% owned by one or more socially and economically disadvantaged individuals, or in the case of a publicly owned business, in which is at least 51% of the stock is owned by one or more socially and economically disadvantaged individuals, and whose management and daily business operations are controlled by one or more of the individuals who own it.

2.2.4. **DBE Joint Venture.** An association of a DBE firm and one or more other firms to carry out a single business enterprise for profit for which purpose they combine their property, capital, efforts, skills, and knowledge, and

in which the DBE is responsible for a distinct, clearly defined portion of the work of the Contract and whose share in the capital contribution, control, management, risks, and profits of the joint venture are commensurate with its ownership interest.

2.2.5. **DOT.** The U.S. Department of Transportation, including the Office of the Secretary, the Federal Highway Administration (FHWA), the Federal Transit Administration (FTA), and the Federal Aviation Administration (FAA).

2.2.6. **Federal-Aid Contract.** Any Contract between the Department and a Contractor that is paid for in whole or in part with DOT financial assistance.

2.2.7. **Good Faith Effort.** All necessary and reasonable steps to achieve the contract goal which, by their scope, intensity, and appropriateness to the objective, could reasonably be expected to obtain sufficient DBE participation, even if not fully successful. Good faith efforts are evaluated prior to award and throughout performance of the Contract. For guidance on good faith efforts, see 49 CFR Part 26, Appendix A.

2.2.8. **North American Industry Classification System (NAICS).** A designation that best describes the primary business of a firm. The NAICS is described in the North American Industry Classification Manual—United States, which is available on the Internet at the U.S. Census Bureau website: http://www.census.gov/eos/www/naics/.

2.2.9. **Race-Conscious.** A measure or program that is focused specifically on assisting only DBEs, including women-owned businesses.

2.2.10. **Race-Neutral DBE Participation.** Any participation by a DBE through customary competitive procurement procedures.

2.2.11. **Texas Unified Certification Program (TUCP) Directory.** An online directory listing all DBEs currently certified by the TUCP. The Directory identifies DBE firms whose participation on a Contract may be counted toward achievement of the assigned DBE Contract goal.

2.3. **Contractor's Responsibilities.**

2.3.1. **DBE Liaison Officer**. Designate a DBE liaison officer who will administer the Contractor's DBE program and who will be responsible for maintenance of records of efforts and contacts made to subcontract with DBEs.

2.3.2. **Compliance Tracking System (CTS)**. This Contract is subject to electronic Contract compliance tracking. Contractors and DBEs are required to provide any noted and requested Contract compliance-related data electronically in the Department's tracking system. This includes commitments, payments, substitutions, and good faith efforts. Contractors and DBEs are responsible for responding by any noted response date or due date to any instructions or request for information, and to check the system on a regular basis. A Contractor is responsible for ensuring all DBEs have completed all requested items and that their contact information is accurate and up-to-date. The Department may require additional information related to the Contract to be provided electronically through the system at any time before, during, or after contract award. The system is web-based and can be accessed at the following Internet address: https://txdot.txdotcms.com/.

In its sole discretion, the Department may require that contract compliance tracking data be submitted by Contractors and DBEs in an alternative format prescribed by the Department.

2.3.3. **Apparent Low Bidder.** The apparent low bidder must submit DBE commitments to satisfy the DBE goal or submit good faith effort Form 2603 and supporting documentation demonstrating why the goal could not be achieved, in whole or part, no later than 5 calendar days after bid opening. The means of transmittal and the risk of timely receipt of the information will be the bidder's responsibility and no extension of the 5-calendar-day timeframe will be allowed for any reason.

2.3.4. **DBE Contractor.** A DBE Contractor may receive credit toward the DBE goal for work performed by its own forces and work subcontracted to DBEs. In the event a DBE subcontracts to a non-DBE, that information must be reported monthly.

2.3.5. **DBE Committal.** Only those DBEs certified by the TUCP are eligible to be used for goal attainment. The Department maintains the TUCP DBE Directory. The Directory can be accessed at the following Internet address: https://txdot.txdotcms.com/FrontEnd/VendorSearchPublic.asp?TN=txdot&XID=2340.

A DBE must be certified on the day the commitment is considered and at time of subcontract execution. It is the Contractor's responsibility to ensure firms identified for participation are approved certified DBE firms.

The Bidder is responsible to ensure that all submittals are checked for accuracy. Any and all omissions, deletions, and/or errors that may affect the end result of the commitment package are the sole liabilities of the bidder.

Commitments in excess of the goal are considered race-neutral commitments.

2.3.6. **Good Faith Effort Requirements.** A Contractor who cannot meet the Contract goal, in whole or in part, must make adequate good faith efforts to obtain DBE participation as so stated and defined in 49 CFR Part 26, Appendix A.

2.3.6.1. **Administrative Reconsideration.** If the Department determines that the apparent low bidder has failed to satisfy the good faith efforts requirement, the Department will notify the Bidder of the failure and will give the Bidder an opportunity to provide written documentation or argument concerning the issue of whether it met the goal or made adequate good faith efforts to do so..

The Bidder must request an administrative reconsideration of that determination within 3 days of the date of receipt of the notice. The request must be submitted directly to the Texas Department of Transportation, Civil Rights Division, 125 East 11th Street, Austin, Texas 78701-2483.

If a request for administrative reconsideration is not filed within the period specified the determination made is final and further administrative appeal is barred.

If a reconsideration request is timely received, the reconsideration decision will be made by the Department's DBE liaison officer or, if the DBE liaison officer took part in the original determination, the Department's executive director will appoint a department employee to perform the administrative reconsideration. The employee will hold a senior leadership position and will report directly to the executive director.

The meeting or written documentation must be provided or held within 7 days of the date the request was submitted.

The Department will provide to the Bidder a written decision if the Bidder did or did not make adequate good faith efforts to meet the Contract goal. The reconsideration decision is final and is not administratively appealed to DOT.

2.3.7. **Determination of DBE Participation.** The work performed by the DBE must be reasonably construed to be included in the work area and NAICS work code identified by the Contractor in the approved commitment.

Participation by a DBE on a Contract will not be counted toward DBE goals until the amount of the participation has been paid to the DBE.

Payments made to a DBE that was not on the original commitment may be counted toward the Contract goal if that DBE was certified as a DBE before the execution of the subcontract and has performed a Commercially Useful Function.

The total amount paid to the DBE for work performed with its own forces is counted toward the DBE goal. When a DBE subcontracts part of the work of its Contract to another firm, the value of the subcontracted work may be counted toward DBE goals only if the subcontractor is itself a DBE.

DBE Goal credit for the DBE subcontractors leasing of equipment or purchasing of supplies from the Contractor or its affiliates is not allowed. Project materials or supplies acquired from an affiliate of the Contractor cannot directly or indirectly (second or lower tier subcontractor) be used for DBE goal credit.

If a DBE firm is declared ineligible due to DBE decertification after the execution of the DBE's subcontract, the DBE firm may complete the work and the DBE firm's participation will be counted toward the Contract goal. If the DBE firm is decertified before the DBE firm has signed a subcontract, the Contractor is obligated to replace the ineligible DBE firm or demonstrate that it has made good faith efforts to do so.

The Contractor may count 100% of its expenditure to a DBE manufacturer. According to 49 CFR 26.55(e)(1)(i), a DBE manufacturer is a firm that operates or maintains a factory or establishment that produces, on the premises, the materials, supplies, articles, or equipment required under the Contract and of the general character described by the specifications.

The Contractor may count only 60% of its expenditure to a DBE regular dealer. According to 49 CFR 26.55(e)(2)(i), a DBE regular dealer is a firm that owns, operates, or maintains a store, warehouse, or other establishment in which the materials, supplies, articles, or equipment of the general character described by the specifications and required under the Contract are bought, kept in stock, and regularly sold or leased to the public in the usual course of business. A firm may be a regular dealer in such bulk items as petroleum products, steel, cement, gravel, stone, or asphalt without owning, operating, or maintaining a place of business if the firm both owns and operates distribution equipment for the products. Any supplementing of regular dealers' own distribution equipment must be by a long-term lease agreement and not on an ad hoc or contract-by-contract basis. A long-term lease with a third-party transportation company is not eligible for 60% goal credit.

With respect to materials or supplies purchased from a DBE that is neither a manufacturer nor a regular dealer, the Contractor may count the entire amount of fees or commissions charged for assistance in the procurement of the materials and supplies, or fees or transportation charges for the delivery of materials or supplies required on a job site.

A Contractor may count toward its DBE goal a portion of the total value of the Contract amount paid to a DBE joint venture equal to the distinct, clearly defined portion of the work of the Contract performed by the DBE.

2.3.8. **Commercially Useful Function.** It is the Contractor's obligation to ensure that each DBE used on federal-assisted contracts performs a commercially useful function on the Contract.

The Department will monitor performance during the Contract to ensure each DBE is performing a CUF.

Under the terms established in 49 CFR 26.55, a DBE performs a CUF when it is responsible for execution of the work of the Contract and is carrying out its responsibilities by actually performing, managing, and supervising the work involved.

With respect to material and supplies used on the Contract, a DBE must be responsible for negotiating price, determining quality and quantity, ordering the material, installing the material, if applicable, and paying for the material itself.

With respect to trucking, the DBE trucking firm must own and operate at least one fully licensed, insured, and operational truck used on the Contract. The DBE may lease trucks from another DBE firm, including an owner-operator who is certified as a DBE. The DBE who leases trucks from another DBE receives credit for the total value of the transportation services the lessee DBE provides on the Contract. The DBE may also lease trucks from a non-DBE firm, including from an owner-operator. The DBE that leases trucks equipped with drivers from a non-DBE is entitled to credit for the total value of transportation services provided by non-DBE leased trucks equipped with drivers not to exceed the value of transportation services on the Contract

provided by DBE-owned trucks or leased trucks with DBE employee drivers. Additional participation by non-DBE owned trucks equipped with drivers receives credit only for the fee or commission it receives as a result of the lease arrangement.

A DBE does not perform a CUF when its role is limited to that of an extra participant in a transaction, Contract, or project through which funds are passed in order to obtain the appearance of DBE participation. The Department will evaluate similar transactions involving non-DBEs in order to determine whether a DBE is an extra participant.

If a DBE does not perform or exercise responsibility for at least 30% of the total cost of its Contract with its own work force, or the DBE subcontracts a greater portion of the work than would be expected on the basis of normal industry practice for the type of work involved, the Department will presume that the DBE is not performing a CUF.

If the Department determines that a DBE is not performing a CUF, no work performed by such DBE will count as eligible participation. The denial period of time may occur before or after a determination has been made by the Department.

In case of the denial of credit for non-performance of a CUF, the Contractor will be required to provide a substitute DBE to meet the Contract goal or provide an adequate good faith effort when applicable.

2.3.8.1. **Rebuttal of a Finding of No Commercially Useful Function.** Consistent with the provisions of 49 CFR 26.55(c)(4)&(5), before the Department makes a final finding that no CUF has been performed by a DBE, the Department will notify the DBE and provide the DBE the opportunity to provide rebuttal information.

CUF determinations are not subject to administrative appeal to DOT.

2.3.9. **Joint Check.** The use of joint checks between a Contractor and a DBE is allowed with Department approval. To obtain approval, the Contractor must submit a completed Form 2178, “DBE Joint Check Approval,” to the Department.

The Department will closely monitor the use of joint checks to ensure that such a practice does not erode the independence of the DBE nor inhibit the DBE’s ability to perform a CUF. When joint checks are utilized, DBE credit toward the Contract goal will be allowed only when the subcontractor is performing a CUF in accordance with 49 CFR 26.55(c)(1).

Long-term or open-ended joint checking arrangements may be a basis for further scrutiny and may result in the lack of participation towards the Contract goal requirement if DBE independence cannot be established.

Joint checks will not be allowed simply for the convenience of the Contractor.

If the proper procedures are not followed or the Department determines that the arrangements result in a lack of independence for the DBE involved, no credit for the DBE’s participation as it relates to the material cost will be used toward the Contract goal requirement, and the Contractor will need to make up the difference elsewhere on the project.

2.3.10. **DBE Termination and Substitution.** No DBE named in the commitment submitted under Section 2.3.5. will be terminated for convenience, in whole or part, without the Department’s approval. This includes, but is not limited to, instances in which a Contractor seeks to perform work originally designated for a DBE subcontractor with its own forces or those of an affiliate, a non-DBE firm, or with another DBE firm.

Unless consent is provided, the Contractor will not be entitled to any payment for work or material unless it is performed or supplied by the listed DBE.

The Contractor, prior to submitting its request to terminate, must first give written notice to the DBE of its intent to terminate and the reason for the termination. The Contractor will copy the Department on the Notice of Intent to terminate.

The DBE has 5 calendar days to respond to the Contractor's notice and will advise the Contractor and the Department of the reasons, if any, why it objects to the proposed termination of its subcontract and why the Department should not approve the prime Contractor's request for termination.

The Department may provide a shorter response time if required in a particular case as a matter of public necessity.

The Department will consider both the Contractor's request and DBE's stated position prior to approving the request. The Department may provide a written approval only if it agrees, for reasons stated in its concurrence document, that the Contractor has good cause to terminate the DBE. If the Department does not approve the request, the Contractor must continue to use the committed DBE firm in accordance with the Contract. For guidance on what good cause includes, see 49 CFR 26.53.

Good cause does not exist if the Contractor seeks to terminate, reduce, or substitute a DBE it relied upon to obtain the Contract so that the Contractor can self-perform the work for which the DBE firm was engaged.

When a DBE subcontractor is terminated, make good faith efforts to find, as a substitute for the original DBE, another DBE to perform, at least to the extent needed to meet the established Contract goal, the work that the original DBE was to have performed under the Contract.

Submit the completed Form 2228, "DBE Termination Substitution Request," within seven (7) days, which may be extended for an additional 7 days if necessary at the request of the Contractor. The Department will provide a written determination to the Contractor stating whether or not good faith efforts have been demonstrated. If the Department determines that good faith efforts were not demonstrated, the Contractor will have the opportunity to appeal the determination to the Civil Rights Division.

2.3.11. **Reports and Records.** By the 15th of each month and after work begins, report payments to meet the DBE goal and for DBE race-neutral participation on projects with or without goals. These payment reports will be required until all DBE subcontracting or material supply activity is completed. Negative payment reports are required when no activity has occurred in a monthly period.

Notify the Area Engineer if payment to any DBE subcontractor is withheld or reduced.

Before receiving final payment from the Department, the Contractor must indicate a final payment on the compliance tracking system. The final payment is a summary of all payments made to the DBEs on the project.

All records must be retained for a period of 3 years following completion of the Contract work, and must be available at reasonable times and places for inspection by authorized representatives of the Department or the DOT. Provide copies of subcontracts or agreements and other documentation upon request.

2.3.12. **Failure to Comply.** If the Department determines the Contractor has failed to demonstrate good faith efforts to meet the assigned goal, the Contractor will be given an opportunity for reconsideration by the Department.

A Contractor's failure to comply with the requirements of this Special Provision will constitute a material breach of this Contract. In such a case, the Department reserves the right to terminate the Contract; to deduct the amount of DBE goal not accomplished by DBEs from the money due or to become due the Contractor; or to secure a refund, not as a penalty but as liquidated damages, to the Department or such other remedy or remedies as the Department deems appropriate.

2.3.13. **Investigations.** The Department may conduct reviews or investigations of participants as necessary. All participants, including, but not limited to, DBEs and complainants using DBE Subcontractors to meet the

Contract goal, are required to cooperate fully and promptly with compliance reviews, investigations, and other requests for information.

2.3.14. **Falsification and Misrepresentation.** If the Department determines that a Contractor or subcontractor was a knowing and willing participant in any intended or actual subcontracting arrangement contrived to artificially inflate DBE participation or any other business arrangement determined by the Department to be unallowable, or if the Contractor engages in repeated violations, falsification, or misrepresentation, the Department may:

- refuse to count any fraudulent or misrepresented DBE participation;
- withhold progress payments to the Contractor commensurate with the violation;
- reduce the Contractor's prequalification status;
- refer the matter to the Office of Inspector General of the US Department of Transportation for investigation; and/or
- seek any other available contractual remedy.

Special Provision Item 000
Important Notice to Contractors

The Contractor's attention is directed to the fact that there are experience requirements associated with the Intelligent Transportation Systems (ITS) items contained on this project. The Contractor or its subcontractor must provide information to the Engineer that they meet these requirements with the initial submittals for the associated bid items and before installing or testing ITS items. Following are the ITS items and requirements that must be met if the item is on this project.

Category A. Pulling Fiber Optic Cable.

Contractor or subcontractor must meet the following experience requirements:

- three years continuous existence offering services in the installation of fiber optic cable through an outdoor conduit system and terminating in ground boxes, field cabinets or enclosures, or buildings; and
- three completed projects where the personnel pulled fiber optic cable, minimum 5-mi. in length, through an outdoor conduit system for each project. The completed fiber optic cable systems must have been in continuous satisfactory operation for a minimum of 1 yr.

Category B. Splicing and Testing of Fiber Optic Cable.

Contractor or subcontractor must meet the following experience requirements:

- three years continuous existence offering services in the fields of fusion splicing and testing of fiber optic cable installed through a conduit system and terminating in ground boxes, field cabinets or enclosures, or buildings. Experience must include the following:
  - termination of a minimum of 48 fibers within a fiber distribution frame,
  - optical time-domain reflectometer (OTDR) testing and measurement of end-to-end attenuation of single mode and multimode fibers,
  - system troubleshooting and maintenance,
  - training of personnel in system maintenance,
  - use of water-tight splice enclosures, and
  - fusion splicing of fiber optic cable which meet the tolerable dB losses listed in Table 1 below; and

Table 1
Sample Table

Mode	dB Loss Range
Single mode	0.05–0.10
Multimode	0.20–0.30

- three completed projects where the personnel performed fiber optic cable splicing and terminations, system testing, system troubleshooting and maintenance during the course of the project and provided training on system maintenance. Each project must have consisted of a minimum 5-mi. length of fiber optic cable. The completed fiber optic cable systems must have been in continuous satisfactory operation for a minimum of 1 yr.

Category C. System Integration.

Contractor or subcontractor must meet the following experience requirements:

- three years of providing system integration on wire line and wireless projects including, but not limited to, programming of layer-2 Ethernet switches, integrating into existing systems and coordination with traffic management centers; and

- three completed projects requiring system integration and configuration of hardware including but not limited to Ethernet switches, video encoders and decoders, and radios.

Category D. Dynamic Message Sign (DMS) Installation.

Contractor or subcontractor must meet the following experience requirements:

- three years continuous existence offering services in the installation of DMS signs; and
- three completed projects consisting of a minimum of two signs in each project where the personnel installed, integrated, and tested DMS on outdoor, permanently mounted overhead structures and related sign control equipment. The completed sign system installations must have been in continuous satisfactory operation for a minimum of 1 yr.; and
- one project (may be one of the three projects in the preceding paragraph) in which the personnel worked in cooperation with technical representatives of the equipment supplier to perform the installation, integration, or acceptance testing of the work. The Contractor will not be required to furnish equipment on this project from the same supplier who was referenced in the qualification documentation.

Category E. Closed Circuit Television (CCTV) Equipment Installation.

Contractor or subcontractor must meet the following experience requirements:

- three years continuous existence offering services in the installation of CCTV camera systems;
- three completed projects consisting of a minimum of five cameras in each project where the personnel installed, tested, and integrated CCTV cameras on outdoor, permanently mounted structures and related camera control and transmission equipment. The completed CCTV camera system installations must have been in continuous satisfactory operation for a minimum of 1 yr.; and
- one project (may be one of the three projects in the preceding paragraph) in which the personnel worked in cooperation with technical representatives of the equipment supplier to perform installation, integration, or acceptance testing of the work. The Contractor will not be required to furnish equipment on this project from the same supplier who was referenced in the qualification documentation.

Category F. Wireless Communications.

Contractor or subcontractor must meet the following experience requirements:

- three years continuous existence offering services in the installation of wireless communications. Experience must include the following:
  - conducting radio installation studies, which include signal noise studies, spectrum analysis, antenna gain and radio power calculations, system attenuation, and measurement of standing wave ratios;
  - Installation, troubleshooting, and repair of broadband radio systems, which include equipment installation, configuration of radios, antenna calibration, and cabling; and
  - Installation, troubleshooting, and repair of interconnected Ethernet networks (LAN and WAN), which include cabling, switch or router configuration, and network analysis; and
- three projects consisting of wireless communications installation, troubleshooting, and repair. Each project must include transmitting signals over a minimum of 1-mi. distance and installation of a minimum of three devices; and
- one project (may be one of the three projects in the preceding paragraph) in which the personnel worked in cooperation with technical representatives of the equipment supplier to perform installation, integration, or acceptance testing of the work. The Contractor will not be required to furnish equipment on this project from the same supplier who was referenced in the qualification documentation.

Category G. Radar Detection Systems.

Contractor or subcontractor must meet the following experience requirements:

- three years continuous existence offering services in the installation of radar detection systems. Experience must include the following:
  - freeway and arterial management,
  - forward fire and side fire applications,
  - single zone and dual beam detection, and
  - equipment setup, testing, and troubleshooting; and
- three projects consisting of installation, configuration, and setup of radar detection systems; and
- one project (may be one of the three projects in the preceding paragraph) in which the personnel worked in cooperation with technical representatives of the equipment supplier to perform installation, integration, or acceptance testing of the work. The Contractor will not be required to furnish equipment on this project from the same supplier who was referenced in the qualification documentation.

Should the Contractor have subcontractors which meet the above requirements, and should these subcontractors be unable to complete the ITS items contained within the project, the Contractor must resubmit qualification material on alternate subcontractors for approval before the applicable category of work can be continued.

Special Provision 000
Notice of Contractor Performance Evaluations

1. GENERAL

In accordance with Texas Transportation Code §223.012, the Engineer will evaluate Contractor performance based on quality, safety, and timeliness of the project.

2. DEFINITIONS

2.1. **Project Recovery Plan (PRP)**—a formal, enforceable plan developed by the Contractor, in consultation with the District, that documents the cause of noted quality, safety, and timeliness issues and specifies how the Contractor proposes to correct project-specific performance deficiencies.

In accordance with Title 43, Texas Administrative Code (TAC), §9.23, the District will request a PRP if the Contractor's performance on a project is below the Department's acceptable standards and will monitor the Contractor's compliance with the established plan.

2.2. **Corrective Action Plan (CAP)**—a formal, enforceable plan developed by the Contractor, and proposed for adoption by the Construction or Maintenance Division, that documents the cause of noted quality, safety, and timeliness issues and specifies how the Contractor proposes to correct statewide performance deficiencies.

In accordance with 43 TAC §9.23, the Division will request a CAP if the average of the Contractor's statewide final evaluation scores falls below the Department's acceptable standards for the review period and will monitor the Contractor's compliance with the established plan.

3. CONTRACTOR EVALUATIONS

In accordance with Title 43, Texas Administrative Code (TAC) §9.23, the Engineer will schedule evaluations at the following intervals, at minimum:

- Interim evaluations—at or within 30 days after the anniversary of the notice to proceed, for Contracts extending beyond 1 yr., and
- Final evaluation—upon project closeout.

In case of a takeover agreement, neither the Surety nor its performing Contractor will be evaluated.

In addition to regularly scheduled evaluations, the Engineer may schedule an interim evaluation at any time to formally communicate issues with quality, safety, or timeliness. Upon request, work with the Engineer to develop a PRP to document expectations for correcting deficiencies.

Comply with the PRP as directed. Failure to comply with the PRP may result in additional remedial actions available to the Engineer under Item 5, "Control of the Work." Failure to meet a PRP to the Engineer's satisfaction may result in immediate referral to the Performance Review Committee for consideration of further action against the Contractor.

The Engineer will consider and document any events outside the Contractor's control that contributed to the failure to meet performance standards or comply with a PRP, including consideration of sufficient time.

Follow the escalation ladder if there is a disagreement regarding an evaluation or disposition of a PRP. The Contractor may submit additional documentation pertaining to the dispute. The District Engineer's decision

on a Contractor's evaluation score and recommendation of action required in a PRP or follow up for non-compliance is final.

4. DIVISION OVERSIGHT

Upon request of the Construction or Maintenance Division, develop and submit for Division approval a proposed CAP to document expectations for correcting deficiencies in the performance of projects statewide.

Comply with the CAP as directed. The CAP may be modified at any time up to completion or resolution after written approval of the premise of change from the Division. Failure to meet an adopted or revised adopted CAP to the Division's satisfaction within 120 days will result in immediate referral to the Performance Review Committee for consideration of further action against the Contractor.

The Division will consider and document any events outside the Contractor's control that contributed to the failure to meet performance standards or comply with a CAP, including consideration of sufficient time and associated costs as appropriate.

5. PERFORMANCE REVIEW COMMITTEE

The Performance Review Committee, in accordance with 43 TAC §9.24, will review at minimum all final evaluations, history of compliance with PRPs, any adopted CAPs including agreed modifications, any information about events outside a Contractor's control contributing to the Contractor's performance, and any documentation submitted by the Contractor and may recommend one or more of the following actions:

- take no action,
- reduce the Contractor's bidding capacity,
- prohibit the Contractor from bidding on one or more projects,
- immediately suspend the Contractor from bidding for a specified period of time, by reducing the Contractor's bidding capacity to zero, or
- prohibit the Contractor from being awarded a Contract on which they are the apparent low bidder.

The Deputy Executive Director will determine any further action against the Contractor.

6. APPEALS PROCESS

In accordance with 43 TAC §9.25, the Contractor may appeal remedial actions determined by the Deputy Executive Director.

Special Provision to Item 2
Instructions to Bidders

Item 2, "Instructions to Bidders," of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Article 2.3., "Issuing Proposal Forms," second paragraph, is supplemented by the following.

The Department will not issue a proposal form if one or more of the following apply:

- the Bidder or affiliate of the Bidder that was originally determined as the apparent low Bidder on a project, but was deemed nonresponsive for failure to submit a DBE commitment as specified in Article 2.14., "Disadvantaged Business Enterprise (DBE)," is prohibited from rebidding that specific project.

Article 2.7., "Nonresponsive Bid," is supplemented by the following:

The Department will not accept a nonresponsive bid. A bid that has one or more of the deficiencies listed below is considered nonresponsive:

- the Bidder failed to submit a DBE commitment as specified in Article 2.14., "Disadvantaged Business Enterprise (DBE)."

Article 2.14., "Disadvantaged Business Enterprise (DBE)," is added.

The apparent low bidder must submit DBE commitment information on federally funded projects with DBE goals within 5 calendar days (as defined in 49 CFR Part 26, Subpart A) of bid opening. For a submission that meets the 5-day requirement, administrative corrections will be allowed.

If the apparent low Bidder fails to submit their DBE information within the specified timeframe, they will be deemed nonresponsive and the proposal guaranty will become the property of the State, not as a penalty, but as liquidated damages. The Bidder forfeiting the proposal guaranty will not be considered in future proposals for the same work unless there has been a substantial change in the design of the work. The Department may recommend that the Commission:

- reject all bids, or
- award the Contract to the new apparent low Bidder, if the new apparent low Bidder submits DBE information within one calendar day of notification by the Department.

If the new apparent low Bidder is unable to submit the required DBE information within one calendar day:

- the new apparent low Bidder will not be deemed nonresponsive,
- the new apparent low Bidder's guaranty will not be forfeited,
- the Department will reject all bids, and
- the new apparent low Bidder will remain eligible to receive future proposals for the same project.

Special Provision to Item 2
Instructions to Bidders

Item 2, "Instructions to Bidders," of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Article 2.3., "Issuing Proposal Forms," is supplemented by the following:

- the Bidder or affiliate of the Bidder that was originally determined as the apparent low Bidder on a project, but was deemed nonresponsive for failure to register or participate in the Department of Homeland Security's (DHS) E-Verify system as specified in Article 2.15., "Department of Homeland Security (DHS) E-Verify System," is prohibited from rebidding that specific project.

Article 2.7., "Nonresponsive Bid," is supplemented by the following:

- the Bidder failed to participate in the Department of Homeland Security's (DHS) as specified in Article 2.15., "Department of Homeland Security (DHS) E-Verify System."

Article 2.15., "Department of Homeland Security (DHS) E-Verify System," is added.

The Department will not award a Contract to a Contractor that is not registered in the DHS E-Verify system. Remain active in E=Verify throughout the life of the contract. In addition, in accordance with paragraph six of Article 8.2, "Subcontracting," include this requirement in all subcontracts and require that subcontractors remain active in E-Verify until their work is completed.

If the apparent low Bidder does not appear on the DHS E-Verify system prior to award, the Department will notify the Contractor that they must submit documentation showing that they are compliant within 5-business days after the date the notification was sent. A Contractor who fails to comply or respond within the deadline will be declared non-responsive and the Department will execute the proposal guaranty. The proposal guaranty will become the property of the State, not as a penalty, but as liquidated damages. The Bidder forfeiting the proposal guaranty will not be considered in future proposals for the same work unless there has been a substantial change in the scope of the work.

The Department may recommend that the Commission:

- reject all bids, or
- award the Contract to the new apparent low Bidder, if the Department is able to verify the Bidder's participation in the DHS E-verify system. For the Bidder who is not registered in E-Verify, the Department will allow for one business day after notification to provide proof of registration.

If the Department is unable to verify the new apparent low Bidder's participation in the DHS E-Verify system within one calendar day:

- the new apparent low Bidder will not be deemed nonresponsive,
- the new apparent low Bidder's guaranty will not be forfeited,
- the Department will reject all bids, and
- the new apparent low Bidder will remain eligible to receive future proposals for the same project.

Special Provision to Item 2
Instructions to Bidders

Item 2, "Instructions to Bidders" of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Article 3., "Issuing Proposal Forms," is supplemented by the following:

The Electronic State Business Daily (ESBD), the Integrated Contractor Exchange (iCX) system, and the project proposal are the official sources of advertisement and bidding information for the State and Local Lettings. Bidders should bid the project using the information found therein, including any addenda. These sources take precedence over information from other sources, including TxDOT webpages, which are unofficial and intended for informational purposes only.

Special Provision to Item 3
Award and Execution of Contract

Item 3, "Award and Execution of Contract" of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Section 4.2., "Bonds," is supplemented by the following:

On the Department's form, provide a warranty bond executed by either the manufacturer of the warranted items or the Contractor, and a U. S. Treasury listed surety with attached powers of attorney and notification information. The warranty bond will be for the total amount of the items that are warranted and furnished as a guarantee for the protection of the Department for all labor, materials, equipment and other incidentals for the replacement of defective work. The party providing the warranty bond is responsible for meeting the warranty requirements.

Special Provision to Item 3
Award and Execution Contract

Item 3, Award and Execution of Contract," of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Section 4.3, "Insurance." The first sentence is voided and replaced by the following:

For construction and building Contracts, submit a certificate of insurance showing coverages in accordance with Contract requirements. For routine maintenance Contracts, refer to Article 8, "Beginning of Work."

Article 8, "Beginning of Work." The first sentence is supplemented by the following:

For a routine maintenance Contract, do not begin work until a certificate of insurance showing coverages in accordance with the Contract requirements is provided and accepted.

Special Provision to Item 3
Award and Execution of Contract

Item 3, "Award and Execution of Contract" of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Section 4.3 "Insurance" is being amended by the following:

Table 2
Insurance Requirements

Type of Insurance	Amount of Coverage
Commercial General Liability Insurance	Not Less Than: $600,000 each occurrence
Business Automobile Policy	Not Less Than: $600,000 combined single limit
Workers' Compensation	Not Less Than: Statutory
All Risk Builder's Risk Insurance (For building-facilities contracts only)	100% of Contract Price

Special Provision to Item 5
Control of the Work

Item 5, "Control of the Work," of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Article 5.1, "Authority of Engineer," is voided and replaced by the following.

The Engineer has the authority to observe, test, inspect, approve, and accept the work. The Engineer decides all questions about the quality and acceptability of materials, work performed, work progress, Contract interpretations, and acceptable Contract fulfillment. The Engineer has the authority to enforce and make effective these decisions.

The Engineer acts as a referee in all questions arising under the terms of the Contract. The Engineer's decisions will be final and binding.

The Engineer will pursue and document actions against the Contractor as warranted to address Contract performance issues. Contract remedies include, but are not limited to, the following:

- conducting interim performance evaluations requiring a Project Recovery Plan, in accordance with Title 43, Texas Administrative Code (TAC) §9.23,
- requiring the Contractor to remove and replace defective work, or reducing payment for defective work,
- removing an individual from the project,
- suspending the work without suspending working day charges,
- assessing standard liquidated damages to recover the Department's administrative costs, including additional project-specific liquidated damages when specified in the Contract in accordance with 43 TAC §9.22,
- withholding estimates,
- declaring the Contractor to be in default of the Contract, and
- in case of a Contractor's failure to meet a Project Recovery Plan, referring the issue directly to the Performance Review Committee for consideration of further action against the Contractor in accordance with 43 TAC §9.24.

The Engineer will consider and document any events outside the Contractor's control that contributed to the failure to meet performance standards, including consideration of sufficient time.

Follow the issue escalation ladder if there is disagreement regarding the application of Contract remedies.

Special Provision to Item 5
Control of the Work

Item 5, “Control of the Work” of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Article 5.4, “Coordination of Plans, Specifications, and Special Provisions,” the last sentence of the last paragraph is replaced by the following:

Failure to promptly notify the Engineer will constitute a waiver of all contract claims against the Department for misunderstandings or ambiguities that result from the errors, omissions, or discrepancies.

Special Provision to Item 6
Control of Materials

Item 6, "Control of Materials" of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Article 6.10., "Hazardous Materials," is voided and replaced by the following:

Comply with the requirements of Article 7.12., "Responsibility for Hazardous Materials."

Notify the Engineer immediately when a visual observation or odor indicates that materials on sites owned or controlled by the Department may contain hazardous materials. Except as noted herein, the Department is responsible for testing, removing, and disposing of hazardous materials not introduced by the Contractor. The Engineer may suspend work wholly or in part during the testing, removing, or disposing of hazardous materials, except in the case where hazardous materials are introduced by the Contractor.

Use materials that are free of hazardous materials. Notify the Engineer immediately if materials are suspected to contain hazardous materials. If materials delivered to the project by the Contractor are suspected to contain hazardous materials, have an approved commercial laboratory test the materials for the presence of hazardous materials as approved. Remove, remediate, and dispose of any of these materials found to contain hazardous materials. The work required to comply with this section will be at the Contractor's expense if materials are found to contain hazardous materials. Working day charges will not be suspended and extensions of working days will not be granted for activities related to handling hazardous material introduced by the Contractor. If suspected materials are not found to contain hazardous materials, the Department will reimburse the Contractor for hazardous materials testing and will adjust working day charges if the Contractor can show that this work impacted the critical path.

10.1. Painted Steel Requirements. Coatings on existing steel contain hazardous materials unless otherwise shown on the plans. Remove paint and dispose of steel coated with paint containing hazardous materials is in accordance with the following:

10.1.1. Removing Paint From Steel For contracts that are specifically for painting steel, Item 446, "Field Cleaning and Painting Steel" will be included as a pay item. Perform work in accordance with that item.

For projects where paint must be removed to allow for the dismantling of steel or to perform other work, the Department will provide for a separate contractor (third party) to remove paint containing hazardous materials prior to or during the Contract. Remove paint covering existing steel shown not to contain hazardous materials in accordance with Item 446, "Field Cleaning and Painting Steel."

10.1.2. Removal and Disposal of Painted Steel. For steel able to be dismantled by unbolting, paint removal will not be performed by the Department. The Department will remove paint, at locations shown on the plans or as agreed, for the Contractor's cutting and dismantling purposes. Utilize Department cleaned locations for dismantling when provided or provide own means of dismantling at other locations.

Painted steel to be retained by the Department will be shown on the plans. For painted steel that contains hazardous materials, dispose of the painted steel at a steel recycling or smelting facility unless otherwise shown on the plans. Maintain and make available to the Engineer invoices and other records obtained from the facility showing the received weight of the steel and the facility name. Dispose of steel that does not contain hazardous material coatings in accordance with federal, state and local regulations.

10.2. Asbestos Requirements. The plans will indicate locations or elements where asbestos containing materials (ACM) are known to be present. Where ACM is known to exist or where previously unknown ACM has been found, the Department will arrange for abatement by a separate contractor prior to or during the Contract. Notify the Engineer of proposed dates of demolition or removal of structural elements with ACM at least 60 days before beginning work to allow the Department sufficient time for abatement.

The Department of State Health Services (DSHS), Asbestos Programs Branch, is responsible for administering the requirements of the National Emissions Standards for Hazardous Air Pollutants, 40 CFR Part 61, Subpart M and the Texas Asbestos Health Protection Rules (TAHPR). Based on EPA guidance and regulatory background information, bridges are considered to be a regulated “facility” under NESHAP. Therefore, federal standards for demolition and renovation apply.

The Department is required to notify the DSHS at least 10 working days (by postmarked date) before initiating demolition or renovation of each structure or load bearing member shown on the plans. If the actual demolition or renovation date is changed or delayed, notify the Engineer in writing of the revised dates in sufficient time to allow for the Department’s notification to DSHS to be postmarked at least 10 days in advance of the actual work.

Failure to provide the above information may require the temporary suspension of work under Article 8.4., “Temporary Suspension of Work or Working Day Charges,” due to reasons under the control of the Contractor. The Department retains the right to determine the actual advance notice needed for the change in date to address post office business days and staff availability.

10.3. Lead Abatement. Provide traffic control as shown on the plans, and coordinate and cooperate with the third party and the Department for managing or removing hazardous materials. Work for the traffic control shown on the plans and coordination work will not be paid for directly but will be subsidiary to pertinent Items.

Special Provision to Item 006
Control of Materials

Item 6, "Control of Materials" of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Section 1.1, "Buy America," The section is removed and replaced by the following:

Comply with the latest provisions of Build America, Buy America Act (BABA Act) of the Bipartisan Infrastructure Law which restricts funds being made available from Federal financial assistance programs unless all the iron products, steel products, manufactured products, and construction materials used in the project are produced in the United States. Use steel or iron products, manufactured products, or construction materials produced in the United States except when:

- a waiver exists exempting the material from Buy America compliance
- the cost of materials, including delivery, does not exceed 0.1% of the total Contract cost or $2,500, whichever is greater,
- the Contract contains an alternate item for a foreign source product and the Contract is awarded based on the alternate item, or
- the materials are temporarily installed.

For construction materials submit a notarized original of TxDOT Construction Material Buy America Certification Form (Department Form 2806) with the proper attachments for verification of compliance.

Construction Materials are classified as an article, material, or supply—other than an item of primarily iron or steel; a manufactured product; cement and cementitious materials; aggregates such as stone, sand, or gravel; or aggregate binding agents or additives —that is or consists primarily of:

- Non-ferrous metals,
- plastic and polymer-based products (including polyvinylchloride, composite building materials, and polymers used in fiber optic cables),
- Glass (including optic glass)
- Lumber, or
- Drywall.

Details shown on the plans provide additional clarification on Buy America requirements for this project.

For steel or Iron materials submit a notarized original of the FORM D-9-USA-1 (Department Form 1818) with the proper attachments for verification of compliance. For Steel or Iron materials the manufacturing process includes any process that modifies the chemical content, physical shape or size, or final finish of a product. The manufacturing process begins with initial melting and mixing and continues through fabrication (cutting, drilling, welding, bending, etc.) and coating (paint, galvanizing, epoxy, etc.).

Article 4., "Sampling, Testing, and Inspection," is supplemented by the following:

Meet with the Engineer and choose either the Department or a Department-selected Commercial Lab (CL) for conducting the subset of project-level sampling and testing shown in Table 1, "Select Guide Schedule Sampling and Testing." Selection may be made on a test by test basis. CLs will meet the testing turnaround times shown (includes test time and time for travel and sampling and reporting) and in all cases issue test reports as soon as possible.

If the Contractor chooses a Department-selected CL for any Table 1 sampling and testing:

- notify the Engineer, District Lab, and the CL of project scheduling that may require CL testing;
- provide the Engineer, District Lab, and CL at least 24 hours' notice by phone or e-mail;
- reimburse the Department for CL Table 1 testing using the contract fee schedule for the CL (including mileage, travel, and stand ime) at the minimum guide schedule testing frequencies;
- reimburse the Department for CL Table 1 testing above the minimum guide schedule frequencies for retesting when minimum frequency testing results in failures to meet specification limits;
- agree with the Engineer and CL upon a policy regarding notification for testing services;
- give any cancellation notice to the Engineer, District Lab, and CL by phone or e-mail;
- reimburse the Department a $150 cancellation fee to cover technician time and mileage charges for previously scheduled work cancelled without adequate notice, which resulted in mobilization of technician and/or equipment by the CL; and
- all CL charges will be reimbursed to the Department by a deduction from the Contractor's monthly pay estimate.

If the CL does not meet the Table 1 turnaround times, testing charge to the Contractor will be reduced by 50% for the first late day and an additional 5% for each succeeding late day.

Approved CL project testing above the minimum testing frequencies in the Guide Schedule of Sampling and Testing, and not as the result of failing tests, will be paid by the Department.

Other project-level Guide Schedule sampling and testing not shown on Table 1 will be the responsibility of the Department.

Table 1
Select Guide Schedule Sampling and Testing (Note 1)

TxDOT Test	Test Description	Turn-Around Time (Calendar days)
SOILS/BASE		
Tex-101-E	Preparation of Soil and Flexible Base Materials for Testing (included in other tests)	
Tex-104-E	Liquid Limit of Soils (included in 106-E)	
Tex-105-E	Plastic Limit of Soils (included in 106-E)	
Tex-106-E	Calculating the Plasticity Index of Soils	7
Tex-110-E	Particle Size Analysis of Soils	6
Tex-113-E	Moisture-Density Relationship of Base Materials	7
Tex-114-E	Moisture-Density Relationship of Subgrade and Embankment Soil	7
Tex-115-E	Field Method for In-Place Density of Soils and Base Materials	2
Tex-116-E	Ball Mill Method for the Disintegration of Flexible Base Material	5
Tex-117-E, Part II	Triaxial Compression Tests For Disturbed Soils and Base Materials (Part II)	6
Tex-113-E **w/** Tex-117-E	Moisture-Density Relationship of Base Materials **with** Triaxial Compression Tests For Disturbed Soils and Base Materials (Part II)	10
Tex-140-E	Measuring Thickness of Pavement Layer	2
Tex-145-E	Determining Sulfate Content in Soils - Colorimetric Method	4
HOT MIX ASPHALT		
Tex-200-F	Sieve Analysis of Fine and Coarse Aggregate (dry, from ignition oven with known correction factors)	1 (Note 2)
Tex-203-F	Sand Equivalent Test	3
Tex-206-F, **w/** Tex-207-F, Part I, **w/** Tex-227-F	**(Lab-Molded Density of Production Mixture – Texas Gyratory)** Method of Compacting Test Specimens of Bituminous Mixtures **with** Density of Compacted Bituminous Mixtures, Part I - Bulk Specific Gravity of Compacted Bituminous Mixtures, **with** Theoretical Maximum Specific Gravity of Bituminous Mixtures	1 (Note 2)
Tex-207-F, Part I **&/or** Part VI	**(In-Place Air Voids of Roadway Cores)** Density of Compacted Bituminous Mixtures, Part I- Bulk Specific Gravity of Compacted Bituminous Mixtures **&/or** Part VI - Bulk Specific Gravity of Compacted Bituminous Mixtures Using the Vacuum Method	1 (Note 2)

Tex-207-F, Part V	Density of Compacted Bituminous Mixtures, Part V- Determining Mat Segregation using a Density-Testing Gauge	3
Tex-207-F, Part VII	Density of Compacted Bituminous Mixtures, Part VII - Determining Longitudinal Joint Density using a Density-Testing Gauge	4
Tex-212-F	Moisture Content of Bituminous Mixtures	3
Tex-217-F	Deleterious Material and Decantation Test for Coarse Aggregate	4
Tex-221-F	Sampling Aggregate for Bituminous Mixtures, Surface Treatments, and LRA (included in other tests)	
Tex-222-F	Sampling Bituminous Mixtures (included in other tests)	
Tex-224-F	Determination of Flakiness Index	3
Tex-226-F	Indirect Tensile Strength Test (production mix)	4
Tex-235-F	Determining Draindown Characteristics in Bituminous Materials	3
Tex-236-F (Correction Factors)	Asphalt Content from Asphalt Paving Mixtures by the Ignition Method (Determining Correction Factors)	4
Tex-236-F	Asphalt Content from Asphalt Paving Mixtures by the Ignition Method (Production Mixture)	1 (Note 2)
Tex-241-F **w/** Tex-207-F, Part I, **w/** Tex-227-F	**(Lab-Molded Density of Production Mixture – Superpave Gyratory)** Superpave Gyratory Compacting of Specimens of Bituminous Mixtures (production mixture) **with** Density of Compacted Bituminous Mixtures, Part I- Part I - Bulk Specific Gravity of Compacted Bituminous Mixtures, **with** Theoretical Maximum Specific Gravity of Bituminous Mixtures	1 (Note 2)
Tex-242-F	Hamburg Wheel-Tracking Test (production mix, molded samples)	3
Tex-244-F	Thermal Profile of Hot Mix Asphalt	1
Tex-246-F	Permeability of Water Flow of Hot Mix Asphalt	3
Tex-280-F	Flat and Elongated Particles	3
Tex-530-C	Effect of Water on Bituminous Paving Mixtures (production mix)	4
AGGREGATES		
Tex-400-A	Sampling Flexible Base, Stone, Gravel, Sand, and Mineral Aggregates	3
Tex-410-A	Abrasion of Coarse Aggregate Using the Los Angeles Machine	5
Tex-411-A	Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate	12
Tex-461-A	Degradation of Coarse Aggregate by Micro-Deval Abrasion	5
CHEMICAL		
Tex-612-J	Acid Insoluble Residue for Fine Aggregate	4
GENERAL		
HMA Production Specialist [TxAPA – Level 1-A] ($/hr)		
HMA Roadway Specialist [TxAPA – Level 1-B] ($/hr)		
Technician Travel/Standby Time ($/hr)		
Per Diem ($/day – meals and lodging)		
Mileage Rate ($/mile from closest CL location)		

Note 1– Turn-Around Time includes test time and time for travel/sampling and reporting.
Note 2 – These tests require turn-around times meeting the governing specifications. Provide test results within the stated turn-around time. CL is allowed one additional day to provide the signed and sealed report.

Special Provision to Item 7
Legal Relations and Responsibilities

Item 7, "Legal Relations and Responsibilities," of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Section 7.7.2., "Texas Pollutant Discharge Elimination System (TPDES) Permits and Storm Water Pollution Prevention Plans (SWP3)," is voided and replaced by the following:

7.2. Texas Pollution Discharge Elimination System (TPDES) Permits and Storm Water Pollution Prevention Plans (SWP3).

7.2.1. Projects with less than one acre of soil disturbance including required associated project specific locations (PSL's) per TPDES GP TXR 150000.

No posting or filing will be required for soil disturbances within the right of way. Adhere to the requirements of the SWP3.

7.2.2. Projects with one acre but less than five acres of soil disturbance including required associated PSL's per TPDES GP TXR 150000.

The Department will be considered a primary operator for Operational Control Over Plans and Specifications as defined in TPDES GP TXR 150000 for construction activity in the right of way. The Department will post a small site notice along with other requirements as defined in TPDES GP TXR 150000 as the entity of having operational control over plans and specifications for work shown on the plans in the right of way.

The Contractor will be considered a Primary Operator for Day-to-Day Operational Control as defined in TPDES GP TXR 150000 for construction activity in the right of way. In addition to the Department's actions, the Contractor will post a small site notice along with other requirements as defined in TPDES GP TXR 150000 as the entity of having day-to-day operational control of the work shown on the plans in the right of way. This is in addition to the Contractor being responsible for TPDES GP TXR 150000 requirements for on- right of way and off- right of way PSL's. Adhere to all requirements of the SWP3 as shown on the plans. The Contractor will be responsible for Implement the SWP3 for the project site in accordance with the plans and specifications, TPDES General Permit TXR150000, and as directed.

7.2.3. Projects with 5 acres or more of soil disturbance including required associated PSL's per TPDES GP TXR 150000.

The Department will be considered a primary operator for Operational Control Over Plans and Specifications as defined in TPDES GP TXR 150000 for construction activities in the right of way. The Department will post a large site notice, file a notice of intent (NOI), notice of change (NOC), if applicable, and a notice of termination (NOT) along with other requirements per TPDES GP TXR 150000 as the entity having operational control over plans and specifications for work shown on the plans in the right of way.

The Contractor will be considered a primary operator for Day-to-Day Operational Control as defined in TPDES GP TXR 150000 for construction activities in the right of way. In addition to the Department's actions, the Contractor shall file a NOI, NOC, if applicable, and NOT and post a large site notice along with other requirements as the entity of having day-to-day operational control of the work shown on the plans in the right of way. This is in addition to the Contractor

being responsible for TPDES GP TXR 150000 requirements for on- right of way and off- right of way PSL's. Adhere to all requirements of the SWP3 as shown on the plans.

Special Provision to Item 7
Legal Relations and Responsibilities

Item 7, "Legal Relations and Responsibilities" of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Section 19.1., Minimum Wage Requirements for Federally Funded Contracts. The second paragraph is voided and replaced by the following:

Submit electronic payroll records to the Engineer using the Department's payroll system.

Section 19.2., Minimum Wage Requirements for State Funded Contracts. The second paragraph is voided and replaced by the following:

Submit electronic payroll records to the Engineer using the Department's payroll system.

Special Provision to Item 7
Legal Relations and Responsibilities

Item 7, "Legal Relations and Responsibilities," of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Section 7.2.4., "Public Safety and Convenience." The first paragraph is deleted and replaced by the following.

Ensure the safety and convenience of the public and property as provided in the Contract and as directed. Keep existing roadways open to traffic or construct and maintain detours and temporary structures for safe public travel. Manage construction to minimize disruption to traffic. Maintain the roadway in a good and passable condition, including proper drainage and provide for ingress and egress to adjacent property.

If the construction of the project requires the closing of a highway, as directed, coordinate the closure with the Engineer and work to ensure all lanes and ramps possible are available during peak traffic periods before, during, and after significant traffic generator events to avoid any adverse economic impact on the municipalities during:

- dates or events as shown on the plans, and
- other dates as directed.

Special Provision to Item 007
Legal Relations and Responsibilities

Item 7, "Legal Relations and Responsibilities," of the Standard Specifications is amended with respect to the clauses cited below.

Section 2.6., "Barricades, Signs, and Traffic Handling," the first paragraph is voided and replaced by the following:

2.6. **Barricades, Signs, and Traffic Handling.** Comply with the requirements of Item 502 "Barricades, Signs, and Traffic Handling," and as directed. Provide traffic control devices that conform to the details shown on the plans, the TMUTCD, and the Department's Compliant Work Zone Traffic Control Device List maintained by the Traffic Safety Division. When authorized or directed, provide additional signs or traffic control devices not required by the plans.

Section 2.6.1., "Contractor Responsible Person and Alternative," is voided and replaced by the following:

2.6.1. **Contractor Responsible Person and Alternative.** Designate in writing, a Contractor's Responsible Person (CRP) and an alternate to be the representative of the Contractor who is responsible for taking or directing corrective measures regarding the traffic control. The CRP or alternate must be accessible by phone 24 hr. per day and able to respond when notified. The CRP and alternate must comply with the requirements of Section 2.6.5., "Training."

Section 2.6.2, "Flaggers," the first paragraph is voided and replaced by the following:

2.6.2. **Flaggers.** Designate in writing, a flagger instructor who will serve as a flagging supervisor and is responsible for training and assuring that all flaggers are qualified to perform flagging duties. Certify to the Engineer that all flaggers will be trained and make available upon request a list of flaggers trained to perform flagging duties.

Section 2.6.5, "Training," is voided and replaced by the following:

2.6.5. **Training.** Train workers involved with the traffic control using Department-approved training as shown on the "Traffic Control Training" Material Producer List.

Coordinate enrollment, pay associated fees, and successfully complete Department-approved training or Contractor-developed training. Training is valid for the period prescribed by the provider. Except for law enforcement personnel training, refresher training is required every 4 yr. from the date of completion unless otherwise specified by the course provider. The Engineer may require training at a frequency instead of the period prescribed based on the Department's needs. Training and associated fees will not be measured or paid for directly but are considered subsidiary to pertinent Items.

Certify to the Engineer that workers involved in traffic control and other work zone personnel have been trained and make available upon request a copy of the certification of completion to the Engineer. Ensure the following is included in the certification of completion:

- name of provider and course title,
- name of participant,
- date of completion, and
- date of expiration.

Where Contractor-developed training or a Department-approved training course does not produce a certification, maintain a log of attendees. Make the log available upon request. Ensure the log is legible and includes the following:

- printed name and signature of participant,
- name and title of trainer, and
- date of training.

2.6.5.1. **Contractor-developed Training.** Develop and deliver Contractor-developed training meeting the minimum requirements established by the Department. The outline for this training must be submitted to the Engineer for approval at the preconstruction meeting. The CRP or designated alternate may deliver the training instead of the Department-approved training. The work performed and materials furnished to develop and deliver the training will not be measured or paid for directly but will be considered subsidiary to pertinent Items.

2.6.5.1.1. **Flagger Training Minimum Requirements.** A Contractor's certified flagging instructor is permitted to train other flaggers.

2.6.5.1.2. **Optional Contractor-developed Training for Other Work Zone Personnel.** For other work zone personnel, the Contractor may provide training meeting the curriculum shown below instead of Department-approved training.

Minimum curriculum for Contractor-provided training is as follows:

Contractor-developed training must provide information on the use of personnel protection equipment, occupational hazards and health risks, and other pertinent topics related to traffic management. The type and amount of training will depend on the job duties and responsibilities. Develop training applicable to the work being performed. Develop training to include the following topics.

- The Life You Save May Be Your Own (or other similar company safety motto).
- Purpose of the training.
  - It's the Law.
  - To make work zones safer for workers and motorist.
  - To understand what is needed for traffic control.
  - To save lives including your own.
- Personal and Co-Worker Safety.
  - **High Visibility Safety Apparel.** Discuss compliant requirements; inspect regularly for fading and reduced reflective properties; if night operations are required, discuss the additional and appropriate required apparel in addition to special night work risks; if moving operations are underway, discuss appropriate safety measures specific to the situation and traffic control plan.
  - **Blind Areas.** A blind area is the area around a vehicle or piece of construction equipment not visible to the operators, either by line of sight or indirectly by mirrors. Discuss the "Circle of Safety" around equipment and vehicles; use of spotters; maintain eye contact with equipment operators; and use of hand signals.
  - **Runovers and Backovers.** Remain alert at all times; keep a safe distance from traffic; avoid turning your back to traffic and if you must then use a spotter; and stay behind protective barriers, whenever possible. Note: It is not safe to sit on or lean against a concrete barrier, these barriers can deflect four plus feet when struck by a vehicle.
  - Look out for each other, warn co-workers.
  - Be courteous to motorists.
  - Do not run across active roadways.
  - Workers must obey traffic laws and drive courteously while operating vehicles in the work zones.
  - Workers must be made aware of company distracted driving policies.
- **Night Time Operations.** Focus should be placed on projects with a nighttime element.

- **Traffic Control Training.** Basics of Traffic Control.
  - Identify work zone traffic control supervisor and other appropriate persons to report issues to when they arise.
  - Emphasize that work zone traffic control devices must be in clean and in undamaged condition. If devices have been hit but not damaged, put back in their correct place and report to traffic control supervisor. If devices have been damaged, replace with new one and report to traffic control supervisor. If devices are dirty, faded or have missing or damaged reflective tape clean or replace and report to traffic control supervisor. Show examples of non-acceptable device conditions. Discuss various types of traffic control devices to be used and where spacing requirements can be found.
  - **Channelizing Devices and Barricades with Slanted Stripes.** Stripes are to slant in the direction you want traffic to stay or move to; demonstrate this with a device.
  - **Traffic Queuing.** Workers must be made aware of traffic queuing and the dangers created by it. Workers must be instructed to immediately notify the traffic control supervisor and other supervisory personnel if traffic is queuing beyond advance warning sign and devices or construction limits.
  - **Signs.** Signs must be straight and not leaning. Report problems to the traffic control supervisor or other as designated for immediate repair. Covered signs must be fully covered. If covers are damaged or out of place, report to traffic control supervisor or other as designated.

Special Provision to Item 8
Prosecution and Progress

Item 8, "Prosecution and Progress" of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Article 8.1., "Prosecution of Work." The first sentence of the first paragraph is voided and replaced by the following:

Begin work 90 calendar days after the authorization date to begin work. Do not begin work before or after this period unless authorized in writing by the Engineer.

Special Provision to Item 8
Prosecution and Progress

Item 8, "Prosecution and Progress" of the Standard Specification is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Article 8.2., "Subcontracting," is supplemented by the following paragraph, which is added as paragraph six to this article:

The Contractor certifies by signing the Contract that the Contractor will not enter into any subcontract with a subcontractor that is not registered in the Department of Homeland Security's (DHS) E-Verify system. Require that all subcontractors working on the project register and require that all subcontractors remain active in the DHS E-Verify system until their work is complete on the project.

Special Provision to Item 8
Prosecution and Progress

Item 8, "Prosecution and Progress" of the Standard Specifications is amended with respect to the clause cited below. No other clauses or requirements of this Item are waived or changed.

Article 8.7.2., "Wrongful Default," is revised and replaced by the following:

If it is determined after the Contractor is declared in default, that the Contractor was not in default, the rights and obligations of all parties will be the same as if termination had been issued for the convenience of the public as provided in Article 8.8 "Termination of Contract."

Special Provision to Item 009
Measurement and Payment

Item 009 "Measurement and Payment" of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Article 9.5., "PROGRESS PAYMENTS" is supplemented with the following:

It is the Department's desire to pay a Contractor for work through the last working day of the month; however, the use of early cut-off dates for monthly estimates and MOH is a project management practice to manage workload at the Area Office level. Approval for using early cut-off dates is at the District's discretion. The earliest cut-off date for estimates is the 25th of the month.

Article 9.6., "PAYMENT FOR MATERIAL ON HAND (MOH)" first paragraph is amended as follows:

If payment for MOH is desired, request compensation for the invoice cost of acceptable nonperishable materials that have not been used in the work before the request, and that have been delivered to the work location or are in acceptable storage places. Nonperishable materials are those that do not have a shelf life or whose characteristics do not materially change when exposed to the elements. Include only materials that have been sampled, tested, approved, or certified, and are ready for incorporation into the work. Only materials which are completely constructed or fabricated on the Contractor's order for a specific Contract and are so marked and on which an approved test report has been issued are eligible. Payment for MOH may include the following types of items: concrete traffic barrier, precast concrete box culverts, concrete piling, reinforced concrete pipe, and illumination poles. Any repairs required after fabricated materials have been approved for storage will require approval of the Engineer before being made and will be made at the Contractor's expense. Include only those materials and products, when cumulated under an individual item or similar bid items, that have an invoice cost of at least $1,000 in the request for MOH payment (e.g. For MOH eligibility, various sizes of conductor are considered similar bid items and may be cumulated to meet the threshold; for small roadside signs, the sign supports, mounting bolts, and the sign face is considered one bid item or similar bid items for more than one pay item for sign supports.) Requests for MOH are to be submitted at least two days before but not later than the estimate cutoff date unless otherwise agreed. If there is a need to request MOH after the established cut-off date, the district can make accommodation as the need arises. This needed accommodation is to be the exception, though, and not the rule.

Special Provision to Item 9
Measurement and Payment

Item 9, "Measurement and Payment" of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Section 9.7.1.4.3., "Standby Equipment Costs," is voided and replaced by the following:

7.1.4.3. **Standby Equipment Costs.** Payment for standby equipment will be made in accordance with Section 9.7.1.4., "Equipment," except that the 15% markup will not be allowed and that:

Section 7.1.4.3.1., "Contractor-Owned Equipment," is voided and replaced by the following:

7.1.4.3.1. **Contractor-Owned Equipment**. For Contractor-owned equipment:

- Standby will be paid at 50% of the monthly Equipment Watch rate after the regional and age adjustment factors have been applied. Operating costs will not be allowed. Calculate the standby rate as follows.

  Standby rate = (FHWA hourly rate - operating costs) × 50%

- If an hourly rate is needed, divide the monthly *Equipment Watch* rate by 176.
- No more than 8 hr. of standby will be paid during a 24-hr. day period, nor more than 40 hr. per week.
- Standby costs will not be allowed during periods when the equipment would have otherwise been idle.

Special Provision to Item 247
Flexible Base

Item 247, "Flexible Base" of the Standard Specifications, is hereby amended with respect to the clauses cited below, and no other clauses or requirements of this Item are waived or changed hereby.

Section 2.4., "Certification." This section is added.

Personnel certified by the Department-approved soils and base certification program must conduct all sampling, field testing, and laboratory testing required by the following:

- Section 2.1, "Aggregate,"
- Section 2.1.3.2, "Recycled Material (Including Crushed Concrete) Requirements,"
- Section 4.3, "Compaction," for measuring flexible base depth, and
- Section 4.3.2, "Density Control," for determining the roadway density and moisture content.

Supply the Engineer with a list of certified personnel and copies of their current certificates before laboratory and field testing is performed and when personnel changes are made. At any time during the project, the Engineer may perform production tests as deemed necessary in accordance with Item 5, "Control of the Work."

Section 2.5., "Reporting and Responsibilities." This section is added.

Use Department-provided templates to record and calculate all test data. Obtain the current version of the templates at http://www.txdot.gov/inside-txdot/forms-publications/consultants-contractors/forms/site-manager.html or from the Engineer. The Engineer and the Contractor will provide any available test results to the other party when requested. Record and electronically submit all test results and pertinent information on Department-provided templates.

Section 2.6., "Sampling." This section is added.

The Engineer will sample flexible base from stockpiles located at the production site or at the project location in accordance with Tex-400-A, Section 5.3. The Engineer will label the sample containers as "Engineer," "Contractor" or "Supplier," and "CST/M&P." Witness the sampling and take immediate possession of the sample containers labeled "Contractor" or "Supplier." The Engineer will maintain custody of the samples labeled "CST/M&P" until testing and reporting is completed.

Section 2.7., "Referee Testing." This section is added.

CST/M&P is the referee laboratory. The Contractor may request referee testing when the Engineer's test results fail to meet any of the material requirements listed in Table 1. Make the request via email within 5 working days after receiving test results from the Engineer. Submit test reports signed and sealed by a licensed professional engineer from a commercial laboratory listed on the Department's Material Producer List (MPL) of laboratories approved to perform compaction and triaxial compression testing located at http://ftp.dot.state.tx.us/pub/txdot-info/cmd/mpl/complabs.pdf. Submit completed test reports electronically on Department-provided templates in their original format. The referee laboratory will report test results to the Engineer within the allowable number of working days listed in Table 2 from the time the referee laboratory receives the samples. It is at the discretion of the Engineer or the referee laboratory to deny a referee request upon review of the test reports provided by the Contractor.

Table 2
Number of Allowable Working Days to Report Referee Test Results

Material Property	Test Method	Working Days
Gradation	Tex-110-E, Part I	5
Liquid Limit (Multi-Point Method)	Tex-104-E, Part I	5
Plasticity Index	Tex-106-E	5
Wet Ball Mill Value	Tex-116-E, Parts I and II	5
Wet Ball Mill, % Increase passing #40 sieve		
Compressive Strength[1]	Tex-117-E, Part II	6
Compressive Strength[2]	Tex-117-E	12

1. Moisture-Density curve provided by the District
2. Moisture-Density curve determined by the referee laboratory

Section 4.6., "Ride Quality." This section is voided and replaced by the following.

Measurement of ride quality only applies to the final travel lanes that receive a 1- or 2-course surface treatment for the final riding surface, unless otherwise shown on the plans. Measure the ride quality of the base course either before or after the application of the prime coat, as directed, and before placement of the surface treatment. Use a certified profiler operator from the Department's MPL. When requested, furnish the Engineer documentation for the person certified to operate the profiler.

Provide all profile data to the Engineer in electronic data files within 3 days of measuring the ride quality using the format specified in Tex-1001-S. The Engineer will use Department software to evaluate longitudinal profiles to determine areas requiring corrective action. Correct 0.1-mi.sections for each wheel path having an average international roughness index (IRI) value greater than 100 in. per mile to an IRI value of 100 in. per mile or less, unless otherwise shown on the plans.

Re-profile and correct sections that fail to maintain ride quality, as directed. Correct re-profiled sections until specification requirements are met, as approved. Perform this work at no additional expense to the Department.

Special Provision to Item 300
Asphalt, Oils, and Emulsions

Item 300, “Asphalt, Oils, and Emulsions” of the Standard Specifications is replaced by Special Specification 3096, “Asphalts, Oils, and Emulsions.” All Item 300 Special Provisions are no longer available, beginning with the April 2022 letting.

Special Provision to Item 302
Aggregates for Surface Treatments

Item 302, "Aggregates for Seal Coats," of the Standard Specifications, is hereby amended with respect to the clauses cited below, and no other clauses or requirements of this Item are waived or changed hereby.

Section 2.1., "Aggregate." Tables 2 and 3 are voided and replaced by the following.

Table 2
Aggregate Gradation Requirements (Cumulative % Retained[1])

Sieve	Grade								
	1	2	3S[2]	3		4S[2]	4	5S[2]	5
				Non-Lightweight	Lightweight				
1"	-	-	-	-	-	-	-	-	-
7/8"	0–2	0	-	-	-	-	-	-	-
3/4"	20–35	0–2	0	0	0	-	-	-	-
5/8"	85–100	20–40	0–5	0–5	0–2	0	0	-	-
1/2"	-	80–100	55–85	20–40	10–25	0–5	0–5	0	0
3/8"	95–100	95–100	95–100	80–100	60–80	60–85	20–40	0–5	0–5
1/4"	-	-	-	95–100	95–100	-	-	65–85	-
#4	-	-	-	-	-	95–100	95–100	95–100	50–80
#8	99–100	99–100	99–100	98–100	98–100	98–100	98–100	98–100	98–100

1. Round test results to the nearest whole number.
2. Single-size gradation.

Table 3
Aggregate Quality Requirements

Property	Test Method	Requirement[1]	
		Minimum	Maximum
SAC	AQMP	As shown on the plans	
Deleterious Material[2], %	Tex-217-F, Part I	-	2.0
Decantation, %	Tex-406-A	-	1.5
Flakiness Index, %	Tex-224-F	-	17
Gradation	Tex-200-F, Part I	Table 2 Requirements	
Los Angeles Abrasion, %	Tex-410-A	-	35
Magnesium Sulfate Soundness, 5 Cycle, %	Tex-411-A	-	25
Micro-Deval Abrasion, %	Tex-461-A	Note 3	
Coarse Aggregate Angularity[4], 2 Crushed Faces, %	Tex-460-A, Part I	85	-
Additional Requirements for Lightweight Aggregate			
Dry Loose Unit Wt., lb./cu. ft.	Tex-404-A	35	60
Pressure Slaking, %	Tex-431-A	-	6.0
Freeze-Thaw Loss, %	Tex-432-A	-	10.0
Water Absorption, 24hr., %	Tex-433-A	-	12.0

1. Material requirements are listed below, unless otherwise shown on the plans.
2. Not required for lightweight aggregate.
3. Used to estimate the magnesium sulfate soundness loss in accordance with Section 2.1.1.
4. Only required for crushed gravel.

Section 2.1.1., "Micro-Deval Abrasion," is added.

The Engineer will perform a minimum of one Micro-Deval abrasion test in accordance with Tex-461-A for each coarse aggregate source per project that has a Rated Source Soundness Magnesium (RSSM) loss value greater than 15 as listed in the BRSQC. The Engineer may waive all Micro-Deval testing based on a satisfactory test history of the same aggregate source.

The Engineer will estimate the magnesium sulfate soundness loss for each coarse aggregate source, when tested, using the following formula.

$Mg_{est.} = (RSSM)(MD_{act.}/RSMD)$

where:
$Mg_{est.}$ = magnesium sulfate soundness loss
$MD_{act.}$ = actual Micro-Deval percent loss
RSMD = Rated Source Micro-Deval

When the estimated magnesium sulfate soundness loss is greater than the maximum magnesium sulfate soundness loss specified, the coarse aggregate source will not be allowed for use unless otherwise approved by the Engineer. The Engineer may require additional testing before granting approval.

Section 2.2., "Precoating." The third paragraph is voided and replaced by the following.

The Engineer retains the right to remove precoat material from aggregate samples in accordance with Tex-210-F, or as recommended by the Construction Division, and test the aggregate to verify compliance with Table 2 and Table 3 requirements. Gradation testing may be performed with precoat intact.

Section 2.3., "Sampling," is added.

Personnel who conduct sampling and witnessing of sampling must be certified by the Department-approved certification program. Supply the Engineer with a list of certified personnel and copies of their current certificates before beginning construction and when personnel changes are made. At any time during the project, the Engineer may perform production tests as deemed necessary in accordance with Item 5, "Control of the Work."

The Engineer will sample aggregate from stockpiles located at the production site, intermediate distribution site, or project location in accordance with Tex-221-F, Section 3.2.3. The Engineer will split each sample into 2 equal portions in accordance with Tex-200-F, Section 3.3, and label these portions "Engineer" and "Contractor" or "Supplier." Witness the sampling and splitting, and take immediate possession of the samples labeled "Contractor" or "Supplier".

Section 2.4., "Reporting and Responsibilities," is added.

The Engineer will provide test results to the Contractor and Supplier within 10 working days from the date the stockpile was sampled for sources listed on the Department's Bituminous Rated Source Quality Catalog (BRSQC), unless otherwise directed. The Engineer will provide test results for the LA Abrasion (Tex-410-A) and Magnesium Sulfate Soundness (Tex-411-A) tests within 30 calendar days for sources not listed on the BRSQC, or for sources not meeting the requirements of Section 2.1.1., "Micro-Deval Abrasion." The Engineer will report to the other party within 24 hours when any test result does not meet the requirements listed in Table 2 or Table 3.

Special Provision to Item 316
Seal Coat

Item 316, "Seal Coat" of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Section 4.8, "Asphalt Placement" is supplemented by the following:

4.8.5. Collect all samples in accordance with Tex-500-C, "Sampling Bituminous Materials, Pre-Molded Joint Fillers, and Joint Sealers" from the distributor and with witness by the Engineer.

At least once per project, collect split samples of each binder grade and source used. The Engineer will submit one split sample to MTD for testing and retain the other split sample.

In addition, collect one sample of each binder grade and source used on the project for each production day. The Engineer will retain these samples.

The Engineer will keep all retained samples for one yr., for hot-applied binders and cutback asphalts; or for two mo., for emulsified asphalts. The Engineer may submit retained samples to MTD for testing as necessary or as requested by MTD.

Special Provision to Item 360
Concrete Pavement

Item 360, "Concrete Pavement" of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Section 360.2.1., "Materials," the third paragraph is voided and replaced by the following:

For continuously reinforced concrete pavements, use a coarse aggregate with a rated coefficient of thermal expansion of not more than 5.5×10^{-6} in./in./°F as listed in the Department's *Concrete Rated Source Quality Catalog*.

Section 360.4.8.3., "Surface Texture," the second paragraph is voided and replaced by the following:

A metal-tine texture finish is required unless otherwise shown on the plans. Provide transverse or longitudinal tining unless otherwise shown on the plans. Immediately following the carpet drag, apply a single coat of evaporation retardant, if needed, at the rate recommended by the manufacturer. Provide the metal-tine finish immediately after the concrete surface has set enough for consistent tining. Operate the metal-tine device to obtain grooves approximately 3/16 in. deep, with a minimum depth of 1/8 in., and approximately 1/12 in. wide. Do not overlap a previously tined area. Use manual methods to achieve similar results on ramps, small or irregular areas, and narrow width sections of pavements. Repair damage to the edge of the slab and joints immediately after texturing. Do not tine pavement that will be overlaid or that is scheduled for blanket diamond grinding or shot blasting.

Special Provision to Item 420
Concrete Substructure

Item 420, “Concrete Substructures” of the Standard Specifications is amended with respect to the clause cited below. No other clauses or requirements of this Item are waived or changed.

Article 420.6., “Payment.” The first paragraph is replaced by the following:

The work performed and materials furnished in accordance with this Item and measured as provided under “Measurement” will be paid for at the unit price bid for the class of concrete and element identified and by the special designation when appropriate. This price is full compensation for furnishing, hauling, and mixing concrete materials; furnishing, bending, fabricating, splicing, welding and placing the required reinforcement; clips, blocks, metal spacers, ties, wire, or other materials used for fastening reinforcement in place; placing, finishing, and curing concrete; mass placement controls; applying ordinary surface finish; furnishing and placing drains, metal flashing strips, and expansion-joint material; excavation, subgrade preparation; and forms and falsework, equipment, labor, tools, and incidentals.

Special Provision to Item 421
Hydraulic Cement Concrete

Item 421, "Hydraulic Cement Concrete" of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Article 421.2., "Materials," the second sentence of the first paragraph is voided and replaced by the following.

Provide aggregates from sources listed in the Department's Concrete Rated Source Quality Catalog (CRSQC).

Article 421.2.2., Supplementary Cementing Materials (SCM), is voided and replaced with the following.

Supplementary Cementing Materials (SCM).

- **Fly Ash**. Furnish fly ash, Modified fly ash (MFA), and Ground Bottom Ash (GBA) conforming to DMS-4610, "Fly Ash."
- **Slag Cement**. Furnish Slag Cement conforming to DMS-4620, "Slag Cement."
- **Silica Fume**. Furnish silica fume conforming to DMS-4630, "Silica Fume."
- **Metakaolin**. Furnish metakaolin conforming to DMS-4635, "Metakaolin."

Article 421.3.1.3., "Agitators and Truck and Stationary Mixers," the first paragraph is voided and replaced by the following.

Provide stationary and truck mixers capable of combining the ingredients of the concrete into a thoroughly mixed and uniform mass and capable of discharging the concrete so that the requirements of Tex-472-A are met.

Article 421.3.1.3., "Agitators and Truck and Stationary Mixers," is supplemented with the following.

Truck mixers with automated water and chemical admixture measurement and slump and slump flow monitoring equipment meeting the requirement of ASTM C 94 will be allowed. Provide data every 6 mo. substantiating the accuracy of slump, slump flow, temperature, water, and chemical admixture measurements. The slump measured by the automated system must be within 1 in. of the slump measured in accordance with Tex-415-A. The concrete temperature measured by the automated system must be within 1°F of concrete temperature measured in accordance with Tex-422-A. The Engineer will not use the automated measurements for acceptance.

Article 421.4.2, "Mix Design Proportioning," Table 8 is voided and replaced by the following.

Table 8
Concrete Classes

Class of Concrete	Design Strength,[1] Min f'_c (psi)	Max w/cm Ratio	Coarse Aggregate Grades[2,3,4]	Cement Types	Mix Design Options	Exceptions to Mix Design Options	General Usage[5]
A	3,000	0.60	1–4, 8	I, II, I/II, IL, IP, IS, IT, V	1, 2, 4, & 7	When the cementitious material content does not exceed 520 lb./cu. yd., any fly ash listed in the MPL may be used at a cement replacement of 20% to 50%.	Curb, gutter, curb & gutter, conc. retards, sidewalks, driveways, back-up walls, anchors, non-reinforced drilled shafts
B	2,000	0.60	2–7				Riprap, traffic signal controller foundations, small roadside signs, and anchors
C[6]	3,600	0.45	1–6	I, II, I/II, IP, IL, IS, IT, V	1–8		Drilled shafts, bridge substructure, traffic rail, culverts except top slab of direct traffic culverts, headwalls, wing walls, inlets, manholes, traffic barrier
E	3,000	0.50	2–5	I, II, I/II, IL, IP, IS, IT, V	1–8	When the cementitious material content does not exceed 520 lb./cu. yd., any fly ash listed in the MPL may be used at a cement replacement of 20% to 50%.	Seal concrete
F[6]	Note[7]	0.45	2–5	I, II, I/II, IP, IL, IS, IT, V			Railroad structures; occasionally for bridge piers, columns, bents, post-tension members
H[6]	Note[7]	0.45	3–6	I, II, I/II, III, IP, IL, IS, IT, V	1–4, 8	Mix design options 1-8 allowed for cast-in-place concrete and the following precast elements unless otherwise stated in the plans: ■ Bridge Deck Panels, ■ Retaining Wall Systems, ■ Coping, ■ Sound Walls, ■ Wall Columns, ■ Traffic Rail, ■ Traffic Barrier, ■ Long/Arch Span Culverts, and ■ precast concrete products included in Items 462, 464, and 465. Do not use Type III cement in mass placement concrete. Up to 20% of blended cement may be replaced with listed SCMs when Option 4 is used for precast concrete. Options 6, & 7 allowed for cast-in-place Class H concrete.	Precast concrete, post-tension members
S[6]	4,000	0.45	2–5	I, II, I/II, IP, IL, IS, IT, V	1–8		Bridge slabs, top slabs of direct traffic culverts, approach slabs
P	See Item 360, "Concrete Pavement."	0.50	2–3	I, II, I/II, IL, IP, IS, IT, V	1–8	When the cementitious material content does not exceed 520 lb./cu. yd., any fly ash listed in the MPL may be used at a cement replacement of 20% to 50%.	Concrete pavement

Class of Concrete	Design Strength,[1] Min f'_c (psi)	Max w/cm Ratio	Coarse Aggregate Grades[2,3,4]	Cement Types	Mix Design Options	Exceptions to Mix Design Options	General Usage[5]
CO[6]	4,600	0.40	6	I, II, I/II, IP, IL, IS, IT, V	1–8		Bridge deck concrete overlay
LMC[6]	4,000	0.40	6–8				Latex-modified concrete overlay
SS[6]	3,600	0.45	4–6		1-8	Use a minimum cementitious material content of 658 lb./cu. yd. of concrete. Limit the alkali loading to 4.0 lbs./cu. yd. or less when using option 7.	Slurry displacement shafts, underwater drilled shafts
K[6]	Note[7]	0.40	Note[7]	I, II, I/II, III IP, IL, IS, IT, V	1-8		Note[7]
HES	Note[7]	0.45	Note[7]	I, IL, II, I/II, III		Mix design options do not apply. 700 lb. of cementitious material per cubic yard limit does not apply.	Concrete pavement, concrete pavement repair
"X" (HPC) [6,8,9]	Note[10]	0.45	Note[10]	I, II, I/II, III IP, IL, IS, IT, V	1–4, & 8	Maximum fly ash replacement for Option 3 may be increased to 50%. Up to 20% of a blended cement may be replaced with listed SCMs for Option 4. Do not use Option 8 for precast concrete.	
"X" (SRC) [6,8,9]	Note[10]	0.45	Note[10]	I/II, II, IP, IL, IS, IT, V	1–4, & 7	When using fly ash, only use fly ashes allowed for SRC as listed in the Fly Ash MPL. Type III-MS may be used where allowed. Type I and Type III cements may be use when fly ashes allowed for SRC as listed in the Fly Ash MPL are used, and with a maximum w/cm of 0.40. Up to 20% of blended cement may be replaced with listed SCMs when Option 4 is used for precast concrete. Use Option 7 for precast concrete where allowed.	

1. Design strength must be attained within 56 days.
2. Do not use Grade 1 coarse aggregate except in massive foundations with 4 in. minimum clear spacing between reinforcing steel bars, unless otherwise permitted. Do not use Grade 1 aggregate in drilled shafts.
3. Use Grade 8 aggregate in extruded curbs unless otherwise approved.
4. Other grades of coarse aggregate maybe used in non-structural concrete classes when allowed by the Engineer.
5. For information only.
6. Structural concrete classes.
7. As shown on the plans or specified.
8. "X" denotes class of concrete shown on the plans or specified.
9. (HPC): High Performance Concrete, (SRC): Sulfate Resistant Concrete.
10. Same as class of concrete shown on the plans.

Article 421.4.2.2., "Aggregates," is supplemented by the following.

Use the following equation to determine if the aggregate combination meets the sand equivalency requirement when blending fine aggregate or using an intermediate aggregate:

$$\frac{(SE_1 \times P_1)+(SE_2 \times P_2)+(SE_{ia} \times P_{ia})}{100} \geq 80\%$$

where:
SE_1 = sand equivalency (%) of fine aggregate 1
SE_2 = sand equivalency (%) of fine aggregate 2
SE_{ia} = sand equivalency (%) of intermediate aggregate passing the 3/8 in. sieve
P_1 = percent by weight of fine aggregate 1 of the fine aggregate blend
P_2 = percent by weight of fine aggregate 2 of the fine aggregate blend
P_{ia} = percent by weight of intermediate aggregate passing the 3/8 in. sieve

Article 421.4.2.3., Chemical Admixtures," the second paragraph is voided and replaced with the following.

Use a 30% calcium nitrite solution when a corrosion-inhibiting admixture is required. Dose the admixture at the rate of gallons of admixture per cubic yard of concrete shown on the plans. Use set retarding admixtures, as needed, to control setting time to ensure concrete containing corrosion inhibiting admixtures remain workable for the entire duration of the concrete placement. Perform setting time testing and slump loss testing during trial batch testing.

Article 421.4.2.5., "Slump," the second paragraph is voided and not replaced. Table 9 is voided and replaced with below:

Table 9
Placement Slump Requirements

General Usage	Placement Slump Range,[1,2] in.
Walls (over 9 in. thick), caps, columns, piers	3 to 7
Bridge slabs, top slabs of direct traffic culverts, approach slabs, concrete overlays, latex-modified concrete for bridge deck overlays	3 to 6
Inlets, manholes, walls (less than 9 in. thick), bridge railing, culverts, concrete traffic barrier, concrete pavement (formed)	4 to 6
Precast concrete	4 to 9
Underwater concrete placements	6 to 8-1/2
Drilled shafts, slurry displaced and underwater drilled shafts	See Item 416, "Drilled Shaft Foundations."
Curb, gutter, curb and gutter, concrete retards, sidewalk, driveways, seal concrete, anchors, riprap, small roadside sign foundations, concrete pavement repair, concrete repair	As approved

1. Maximum slump values may be increase above these values shown using chemical admixtures, provided the admixture treated concrete has the same or lower water-to-cementitious ratio and does not exhibit segregation or excessive bleeding. Request approval to increase slump limits in advance for proper evaluation by the Engineer.
2. For fiber reinforced concrete, perform slump before addition of fibers.

Article 421.4.2.6., "Mix Design Options", is voided and replaced with the following.

Option 1. Replace cement with at least the minimum dosage listed in the Fly Ash MPL for the fly ash used in the mixture. Do not replace more than 50% of the cement with fly ash.

Option 2. Replace 35% to 50% of the cement with slag cement.

Option 3. Replace 35% to 50% of the cement with a combination of fly ash, slag cement, MFA, metakaolin, or at least 3% silica fume; however, no more than 35% may be fly ash, and no more than 10% may be silica fume.

Option 4. Use Type IP, Type IS, or Type IT cement as allowed in Table 8 for each class of concrete. Up to 10% of a Type IP, Type IS, or Type IT cement may be replaced with fly ash, slag cement, or silica fume. Use no more than 10% silica fume in the final cementitious material mixture if the Type IT cement contains silica fume, and silica fume is used to replace the cement.

Option 5. Option 5 is left intentionally blank.

Option 6. Use a lithium nitrate admixture at a minimum dosage determined by testing conducted in accordance with Tex-471-A. Before use of the mix, provide an annual certified test report signed and sealed by a licensed professional engineer, from a laboratory on the Department's MPL, certified by the Construction Division as being capable of testing according to Tex-471-A.

Option 7. Ensure the total alkali contribution from the cement in the concrete does not exceed 3.5 lb. per cubic yard of concrete when using hydraulic cement not containing SCMs calculated as follows:

$$\text{lb. alkali per cu. yd.} = \frac{(\text{lb. cement per cu. yd.}) \times (\%\ Na_2O \text{ equivalent in cement})}{100}$$

In the above calculation, use the maximum cement alkali content reported on the cement mill certificate.

Option 8. Use Table 10 when deviating from Options 1–3 or when required by the Fly Ash MPL. Perform required testing annually and submit results to the Engineer. Laboratories performing ASTM C1260, ASTM C1567, and ASTM C1293 testing must be listed on the Department's MPL. Before use of the mix, provide a certified test report signed and sealed by a licensed professional engineer demonstrating the proposed mixture conforms to the requirements of Table 10.

Provide a certified test report signed and sealed by a licensed professional engineer, when HPC is required, and less than 20% of the cement is replaced with SCMs, demonstrating ASTM C1202 test results indicate the permeability of the concrete is less than 1,500 coulombs tested immediately after either of the following curing schedules:

- Moisture cure specimens 56 days at 73°F.
- Moisture cure specimens 7 days at 73°F followed by 21 days at 100°F.

Table 10
Option 8 Testing and Mix Design Requirements

Scenario	ASTM C1260 Result		Testing Requirements for Mix Design Materials or Prescriptive Mix Design Options
	Mix Design Fine Aggregate	Mix Design Coarse Aggregate	
A	> 0.10%	> 0.10%	Determine the dosage of SCMs needed to limit the 14-day expansion of each aggregate[1] to 0.10% when tested individually in accordance with ASTM C1567.
B	≤ 0.10%	≤ 0.10%	Use the minimum replacement listed in the Fly Ash MPL, or When Option 8 is listed on the MPL, use a minimum of 40% fly ash with a maximum CaO[2] content of 25%, or Use any ternary combination which replaces 35% to 50% of cement.
	≤ 0.10%	ASTM C1293 1 yr. Expansion ≤ 0.04%	Use a minimum of 20% of any fly ash; or Use any ternary combination which replaces 20% to 50% of cement.
C	≤ 0.10%	> 0.10%	Determine the dosage of SCMs needed to limit the 14-day expansion of coarse and intermediate[1] aggregate to 0.10% when tested individually in accordance with ASTM C1567.
D	> 0.10%	≤ 0.10%	Use the minimum replacement listed in the Fly Ash MPL, or When Option 8 is listed on the MPL, use a minimum of 40% fly ash with a maximum CaO[2] content of 25%, or Use any ternary combination which replaces 35% to 50% of cement.
	> 0.10%	ASTM C1293 1 yr. Expansion ≤ 0.04%	Determine the dosage of SCMs needed to limit the 14-day expansion of each fine aggregate to 0.10% when individually tested in accordance with ASTM C1567.

1. Intermediate size aggregates will fall under the requirements of mix design coarse aggregate.
2. Average the CaO content from the previous ten values as listed on the test certificate.

Article 421.4.2.7., "Optimized Aggregate Gradation (OAG) Concrete," the first sentence of the first paragraph is voided and replaced by the following.

The gradations requirements in Table 4 and Table 6 do not apply when OAG concrete is specified or used by the Contractor unless otherwise shown on the plans.

The fineness modulus for fine aggregate listed in Table 5, does not apply when OAG Concrete is used,

Article 421.4.6.2., Delivering Concrete," the third paragraph is supplemented by the following.

When truck mixers are equipped with automated water or chemical admixture measurement and slump or slump flow monitoring equipment, the addition of water or chemical admixtures during transit is allowed. Reports generated by this equipment must be submitted to the Engineer daily.

Article 421.4.6.2., "Delivering Concrete," the fifth paragraph is voided and replaced with the following. Begin the discharge of concrete delivered in truck mixers within the times listed in Table 14. Concrete delivered after these times, and concrete that has not begun to discharge within these times will be rejected

Article 421.4.8.3., "Testing of Fresh Concrete," is voided and replaced with the following.

Testing Concrete. The Engineer, unless specified in other Items or shown on the plans, will test the fresh and hardened concrete in accordance with the following methods:

- Slump. Tex-415-A;
- Air Content. Tex-414-A or Tex-416-A;
- Temperature. Tex-422-A;
- Making and Curing Strength Specimens. Tex-447-A;
- Compressive Strength. Tex-418-A;
- Flexural Strength. Tex-448-A; and
- Maturity. Tex-426-A.

Flexural strength and maturity specimens will not be made unless specified in other items or shown on the plans.

Concrete with slump less than minimum required after all addition of water withheld will be rejected, unless otherwise allowed by the Engineer. Concrete with slump exceeding maximum allowed may be used at the contractor's option. If used, Engineer will make, test, and evaluate strength specimens as specified in Article 421.5., "Acceptance of Concrete." Acceptance of concrete not meeting air content or temperature requirements will be determined by Engineer. Fresh concrete exhibiting segregation and excessive bleeding will be rejected.

Article 421.4.8.3.1. "Job-Control Testing," is voided and not replaced.

Special Provision to Item 426
Post-Tensioning

Item 426, "Post-Tensioning" of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Section 2.1., "Prestressing Steel." The first bullet is voided and replaced with the following.

- Seven-wire steel strand meeting DMS-4500, "Steel Strand, Uncoated Seven-Wire Low Relaxation for Prestressed Concrete," or

Section 2.2., "Post-Tensioning System." The second bulleted item is voided and replaced with the following:

- Provide pre-packaged grouts in accordance with DMS-4670, "Grouts for Post-Tensioning." Do not use grouts that exceed the manufacturers' recommended shelf life or 6 mo. after date of manufacture, whichever is less.

Section 4.2., "Required Submittals." The section is voided and replaced with the following.

4.2. **Required Submittals.** Submit information required in this Section for post-tensioned elements, in addition to forming and falsework plans required by Item 420, "Concrete Substructures," and Item 424, "Precast Concrete Structural Members (Fabrication)." Include all necessary construction information in these submittals for cast-in-place and precast construction including, but not limited to the information required in this Section.

4.2.1. **Design Calculations**. Provide design procedures, coefficients, allowable stresses, tendon spacing, and clearances in accordance with the AASHTO LRFD *Bridge Design Specifications* and PTI/ASBI M50 unless otherwise shown on the plans. Submit enough calculations to support the proposed system and method of post-tensioning including friction loss diagrams. When the required jacking force for a particular type of tendon, duct, and configuration is furnished on the plans, design calculations are not required except to adjust for conditions different from those shown on the plans.

4.2.2. **Post-Tensioning Details**. Provide drawings with details that meet the requirements of PTI/ASBI M50 and this Specification.

4.2.3. **Grouting Plan**. Submit for approval written grouting procedures at least four weeks before the start of the element's construction. Include items required by PTI M55.

Include the names of people responsible for PT installation and grouting operations, with the foreman of each grouting crew certified as a PTI Level 2 Bonded PT Field Specialist and ASBI Certified Grouting Technician.

4.2.4. **Stressing Safety Plan**. Provide a plan to protect the public, workers, and Department personnel on and around the vicinity where post-tensioning operations are occurring.

Submit for approval, a detailed safety plan which identifies potential risk associated with post-tensioning operations, including but not limited to:

- tendon alignment,
- temporary shoring,
- ram operations, and
- stand anchorage.

Section 4.3., "Design Calculations." The section is voided and replaced with the following.

4.3. **Packaging, Storing, and Handling of Post-Tensioning Components**. Package, store, and handle post-tensioning steel, grout, duct, and other accessories in accordance with PTI/ASBI M50 and PTI M55 unless otherwise indicated. Acceptance and rejection criteria for strand will follow PTI/ASBI M50 and PTI M55.

The following exceptions apply:

- grout storage onsite will be limited to 30 days unless approval by the Engineer is given in advance of material delivery,
- install grout caps and ensure vents are closed at all times so that water and other contaminants cannot enter the duct before strand installation, and
- do not flush ducts at any time.

Section 4.4., "Packaging, Storing, and Handling of Post-Tensioning Components." The section is voided and replaced with the following.

4.4. **Duct and Prestressing Steel Installation for Post-Tensioning**. Follow PTI/ASBI M50 for duct and prestressing steel installation procedures and requirements unless otherwise specified. Verify that concrete strength requirements on the plans are met for stressing and staged loading of post-tensioned structural elements.

Stress the tendons within seven days of installing the strand in the ducts unless otherwise approved in advance. Follow the tensioning procedure noted in the approved post-tensioning details.

Section 4.5., "Duct and Prestressing Steel Installation for Post-Tensioning." The section is voided and replaced with the following.

4.5. **Grouting**. Grout in accordance with PTI M55.

Grout within 14 days of tendon stressing unless otherwise specified or approved. Obtain approval to extend the grouting time before stressing tendons.

Do not allow the grout temperature to exceed 85°F during mixing and pumping. Do not grout when the ambient temperature is below 35°F. Field-test the grout in accordance with Table 1 during grout installation. Perform field-testing by trained personnel at the Contractor's expense while witnessed by the Engineer. Pump at the lowest pressure possible that will maintain a continuous flow of grout.

Table1
Requirements for Field-Testing of Grout

Test	Frequency	Requirement
Schupak Pressure Bleed Test (ASTM C1741)	1 per day	Per DMS-4670
Fluidity test (Tex-437-A, Method 2)	2 every 2 hr. 2 min. per day	per DMS-4670
Compressive Strength test (3" × 6" cylinders)	1 per day	per DMS-4670
Mud Balance test (Tex-130-E, Part II)[1, 2]	2 per day	per PTI M55

1. Take one sample from the mixer and one sample from the farthest duct outlet.
2. Verify wet density is within the range established by the department.

Section 4.6., "Grouting." The section is voided and not replaced.

Article 5., "MEASUREMENT AND PAYMENT." The section is voided and replaced with the following.

5. **MEASUREMENT**

This Item will be measured by the each PT element or member. An element or member is defined by one of the following individual components.

- PT Cap

- PT Column
- PT Bent
- Other elements shown in the plans.

The PT may extend into other elements which is subsidiary to the main element being post-tensioned.

6. **PAYMENT**

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "PT" for the member type shown on the plans. This price is full compensation for submittals, mock-ups, prestressing steel, post-tensioning, ducts, grout fittings, grout, end anchorages, bearing plates, equipment, labor, materials, tools, and incidentals. Materials furnished for testing will not be paid for directly.

Post-tensioning of precast members, tensioned at a fabrication plant, will not be paid for directly but will be subsidiary to pertinent Items.

Special Provision to Item 427
Surface Finishes for Concrete

Item 427, "Surface Finishes for Concrete" of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Article 427.2.1 "Coatings," is supplemented with the following:

Epoxy Waterproofing. Provide Type X Epoxy per DMS-6100 "Epoxies and Adhesives." Match color of coating with Federal Standard 595C color 35630, concrete gray, unless otherwise shown on the plans.

Article 427.4.2.2 "Application," is supplemented with the following:

Epoxy Waterproofing. Mix epoxy per manufacturer's instructions. Apply the coating on a dry surface at a maximum application rate of 100 sq. ft per gallon. Apply a thin uniform film of mixed epoxy to the substrate by the use of a short nap roller or brush. The epoxy may be sprayed following the thinning requirements of the manufacturer. No more than 15% reduction is permitted.

Match the color of the applied coating with the color standard shown on the plans. Apply when ambient temperature is between 50°F and 100°F.

Article 427.6 "Payment," the second paragraph is voided and replaced in its entirety with:

When a surface finish for concrete is specified as a pay item, the work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Adhesive Grout Finish," "Concrete Paint Finish," "Opaque Sealer Finish," "Silicone Resin Paint Finish," "Epoxy Waterproof Finish," or "Blast Finish." This price is full compensation for materials; cleaning and preparing surfaces; application of materials; and equipment, labor, tools, and incidentals.

Special Provision to Item 440
Reinforcement for Concrete

Item 440, "Standard Specification Title" of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Article 440.2., "Materials" is supplemented with the following:

2.14. Provide zinc-coated, hot-dip galvanized Class I or II steel reinforcement conforming to ASTM A767, Grades 60 or 75 when shown on the plans and as allowed.

2.15. Provide continuously hot-dip galvanized reinforcement (CGR) conforming to ASTM A1094 steel reinforcement, Grades 60 or 75 when shown on the plans and as allowed.

Article 440.2.5., "Weldable Reinforcing Steel" is supplemented with the following:

All welding operations must be performed prior to hot-dip galvanizing.

Article 440.2.8., "Mechanical Couplers" is supplemented with the following:

Provide hot-dipped or mechanically galvanized couplers when splicing galvanized reinforcing or continuously galvanized reinforcing.

Article 440.2.11., "Low-Carbon, Chromium Reinforcing Steel." The first sentence is voided and replaced by the following:

Provide deformed steel bars conforming to ASTM A1035, Grade 100, Type CS when low-carbon, chromium reinforcing steel is required on the plans. Type CM will only be permitted if specified on the plans.

Article 440.3.1., "Bending" is supplemented with the following:

Do not bend hot-dip galvanized reinforcement. Only minor positioning adjustments are permitted.

Bending of continuously galvanized reinforcement is permitted after galvanizing.

Article 440.3.5, "Placing" the following will be added to paragraph four.

Use Class 1 or 1A supports with continuously galvanized reinforcing. Provide epoxy or plastic-coated tie wires and clips for use with epoxy coated reinforcing steel.

Article 440.3.6.3., "Repairing Coating" is supplemented with the following:

Repair damaged galvanized surfaces in accordance with Article 445.3.5.2. "Repair Processes."

Special Provision to Item 441
Steel Structures

Item 441, "Steel Structures" of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Section 441.2.2., Approved Electrodes and Flux-Electrode Combinations," is voided and replaced with the following:

Use only electrodes and flux-electrode combinations conforming to AWS A5 specifications, and pertinent classifications for the applicable welding processes. When requested, submit a current Certificate of Conformance (COC) containing all test results as required by the applicable AWS A5 specification and welding code. Provide proof of Buy America compliance for welding consumables when requested. For bridge main member fabrication, submit the COC annually.

Section 441.2.3., "High-Strength Bolts," is revised and replaced by the following:

Use fasteners that meet Item 447, "Structural Bolting." Use galvanized fasteners on field connections of bridge members when ASTM F3125-Grade A325 bolts are specified, and steel is painted.

Section 441.3.1.5.1., "Plants," The second and third paragraphs are voided and replaced with the following:

Fabrication plants that produce the following non-bridge steel members must be approved in accordance with DMS-7380, "Steel Non-Bridge Member Fabrication Plant Qualification."

- Item 610, "Roadway Illumination Poles"
- Item 613, "High Mast Illumination Poles"
- Item 614, "High Mast Rings and Support Assemblies"
- Item 650, "Overhead Sign Support Structures"
- Item 654, "Sign Walkways"
- Item 686, "Traffic Signal Poles"
- Special Specification 6064, "Intelligent Transportation System (ITS) Poles."

The Materials and Tests Division (MTD) maintains a list of approved non-bridge fabrication plants on the Department MPL that produce these members.

Section 441.3.1.6.1., "Erection Drawings," the third paragraph is voided and replaced with the following:

Perform erection engineering evaluation of the structural adequacy and stability of constructing the bridge system for each step of the steel erection.

Section 441.3.1.5.3., "Nondestructive Testing (NDT)," is voided and replaced with the following:

Personnel performing NDT must be qualified in accordance with the applicable AWS code and the employer's Written Practice. Level III personnel who qualifies Level I and Level II technicians must be certified by ASNT for which the NDT Level III is qualified. In addition, NDT technicians must pass hands-on tests that MTD administers. This will remain current provided they continue to perform testing on Department materials as evidenced by test reports requiring their signature. A technician who fails any of the hands-on tests must wait 3 mo. or as approved otherwise before retesting. Qualification to perform NDT will be revoked when the technician's employment is terminated or when the technician goes 6 mo. without performing a test on a Department project. The technician must pass a new hands-on test to be re-certified. Testing of similar weld joints for non-Department projects may be considered by the Engineer instead of re-testing provided enough documentation is submitted with the signature of the project's Engineer. These requirements also apply to testing agencies, and individual third-party contractors.

Section 441.3.1.5.4., "Welding Procedure Specification Qualification Testing," is voided and replaced by the following:

For Fabricators qualified in accordance with DMS-7370, DMS-7380, or DMS-7395, laboratories performing procedure qualification testing for welding procedure specifications (WPSs) must be accredited by a nationally recognized agency that performs testing in accordance with ISO/International Electrotechnical Commission (IEC) 17025 in the mechanical field of testing.

Section 441.3.1.9., "Material Identification," is amended to include the following paragraph:

Low-stress stencil marks must have a radius instead of a sharp point. Acceptable stencils include dot, vibration, and rounded-V stencils. Label these stencils so that they are easily distinguishable from other stencils that are not low-stress.

Section 441.3.2.4.1., "Flange Tilt," the last sentence is voided and replaced with the following:

Minor jacking that does not deform the material will be permitted.

Section 441.3.2.5.3., "Magnetic Particle Testing," is voided and replaced with the following:

Use alternating current (AC) when using the yoke method unless otherwise approved. Welds may be further evaluated with half-wave rectified DC for subsurface indications. Centerline cracking may be detected with aluminum prod method when approved.

Section 441.3.5.8., "Hammering," is added to state the following:

Do not perform hammering on any portion of the member that causes the material to permanently deform. Avoid damage to the material by measures such as use of brass or aluminum hammers or by padding the area to be hammered.

Section 441.3.8.1., "Shop Painting," is amended to include with the following paragraph:

Measure the anchor profile after blast cleaning at random locations along the thermal cut surfaces. If specified anchor profile is not achieved over the entire flame cut surface, grind the edges and re-blast to achieve the required anchor pattern.

Section 441.3.9., "Handling and Storage of Materials," The second sentence of the second paragraph is replaced by the following:

Keep materials clean and avoid damaging of the applied coating.

Special Provision to Item 442
Metal for Structures

Item 442, "Metal for Structures" of the Standard Specifications is amended with respect to the clause cited below. No other clauses or requirements of this Item are waived or changed.

Section 442.2.1.3.3., "Fasteners." The first sentence of the first paragraph is replaced by the following:

Fasteners. Provide high-strength bolts that meet ASTM F3125-Grade A325 unless otherwise shown on the plans.

Section 442.2.1.3.3., "Fasteners." The third paragraph is deleted and not replaced.

Special Provision to Item 446
Field Cleaning and Painting Steel

For this project, Item 446, "Field Cleaning and Painting Steel," of the Standard Specifications, is hereby amended with respect to the clauses cited below, and no other clauses or requirements of this Item are waived or changed hereby.

Section 446.4.1., "Qualification," the first and second paragraphs are voided and replaced by the following:

> Submit to the Engineer documentation verifying SSPC QP 1 or NACE NIICAP AS-1 certification for work requiring the removal or application of coatings. Additionally, submit to the Engineer documentation verifying SSPC QP 2 Cat A or NACE NIICAP AS-2 certification when work requires removal of coatings containing hazardous materials. Maintain certifications throughout the project. No work may be performed without current and active certifications unless otherwise shown on the plans. The Engineer may waive certification requirements for minor, touch-up repair work and coating steel members repaired in accordance with Item 784, "Steel Member Repair."
>
> The Engineer may waive certification requirements, when stated on the plans, for the purpose of qualification in either contractor certification program if the project has been accepted as a qualification project as part of the process for obtaining SSPC QP1 Cat A or NACE NIICAP AS-1 certification. Submit certification applications and proof of acceptance before beginning work or provide SSPC QP 7 certification when required on the plans.

Section 446.4.7.3.2., "Classes of Cleaning," is amended with the following:

> Prepare all surfaces of painted steel members subsequently exposed from structural operations, such as deck removal or steel repair, in accordance with this Item. Prevent loose or damaged paint from entering the environment.

Special Provision to Item 448
Structural Field Welding

Item 448, "Structural Field Welding" of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Article 448.2., "Materials," the third paragraph is voided and replaced with the following:

Use only electrodes and flux-electrode combinations conforming to AWS A5 specifications and pertinent classifications for the applicable welding processes. When requested, submit a current Certificate of Conformance (COC) containing acceptable wording indicating Buy America compliance and all tests required by the applicable AWS specifications and welding codes. Tests must be conducted on electrodes of the same class, size, and brand; and manufactured by the same process and with the same materials as the electrodes to be furnished.

Special Provision to Item 449
Anchor Bolts

Item 449, "Anchor Bolts" of the Standard Specifications is amended with respect to the clause cited below. No other clauses or requirements of this Item are waived or changed.

Section 449.2.1., "Bolts and Nuts." Table 1 is replaced by the following:

Table 1
Bolt and Nut Standards

Specified Anchor Bolt Category	Bolt Standards	Nut Standards
Mild steel	ASTM A307 Gr. A, F1554 Gr. 36, or A36	ASTM A563
Medium-strength, mild steel	ASTM F1554 Gr. 55 with supplementary requirement S1	ASTM A194 Gr. 2 or A563 Gr. D or better
High-strength steel	ASTM F3125-Grade A325 or ASTM A449[1]	ASTM A194 or A563, heavy hex
Alloy steel	ASTM A193 Gr. B7 or F1554 Gr. 105	ASTM A194 Gr. 2H or A563 Gr. DH, heavy hex

1. **If headed bolts are specified, ASTM A449 bolts must be heavy hex head.**

Section 449.3.3.1,"Anchor Bolt Thread Lubricant Coating," The first sentence of the first paragraph is voided and replaced by the following.

Coat anchor bolt threads before installing nuts with an electrically conducting lubricant compound described in Section 449.3.3.2.1., "Definitions," for traffic signal poles, roadway illumination poles, high mast illumination poles, intelligent transportation system poles, overhead sign support structures, and steel electrical service supports.

Section 449.3.3.2,"Anchor Bolt Tightening Procedure," The first sentence of the first paragraph is voided and replaced by the following.

Tighten anchor bolts for traffic signal poles, shoe base and concrete traffic barrier base roadway illumination poles, high mast illumination poles, intelligent transportation system poles, and overhead sign support structures in accordance with this Section.

Special Provision to Item 450
Railing

Item 450, "Railing" of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Section 450.3.1.2., "Fabrication," is supplemented with the following.

Fabrication plants that produce metal railing (steel and aluminum) must be approved in accordance with DMS-7395, "Metal Railing Fabrication Plant Qualification." This required approval does not include fabricators of chain link fence. The Materials and Tests Division maintains a MPL of approved fabrication plants of metal railing.

Permanently mark each metal railing post base plate, at a visible location when erected, with the fabrication plant's insignia or trademark. For fabricated rail panels, provide this permanent mark on one post base plate, per panel.

Special Provision to Item 465
Junction Boxes, Manholes, and Inlets

Item 465, "Junction Boxes, Manholes, and Inlets," of the Standard Specifications, is hereby amended with respect to the clauses cited below, and no other clauses or requirements of this Item are waived or changed hereby.

Section 2.1., "Concrete," The section is voided and replaced with the following.

Furnish concrete per DMS-7305 for formed and machine-made precast junction boxes, manholes, and inlets. Furnish Class C concrete for cast-in-place junction boxes, manholes, and inlets unless otherwise shown on the plans.

Section 3.1., "Precast Junction Boxes, Manholes, and Inlets," The section is voided and replaced with the following.

Construct formed and machine-made precast junction boxes, manholes, and inlets in accordance with DMS-7305, "Fabrication and Qualification Procedure for Multi-Project Fabrication Plants of Precast Concrete Drainage Structures" and the Contract Plans, except as otherwise noted in this Item.

Multi-project fabrication plants as defined in Item 424 "Precast Concrete Structural Members (Fabrication)," that produce junction boxes, manholes, and inlets will be approved by the Materials and Tests Division in accordance with DMS-7305, "Fabrication and Qualification Procedure for Multi-Project Fabrication Plants of Precast Concrete Drainage Structures." The Department's MPL has a list of approved multi-project fabrication plants.

Section 3.1.1., "Lifting Holes," The section is voided and not replaced.

Section 3.1.2., "Marking." The section is voided and replaced with the following.

Marking. Clearly mark each precast junction box, manhole, and inlet unit with the following information:

- name or trademark of fabricator and plant location;
- product designation;
- ASTM designation (if applicable);
- date of manufacture;
- designation "TX" for precast units fabricated per DMS-7305;
- designated fabricator's approval stamp for each approved unit; and
- designation "SR" for product meeting sulfate-resistant concrete plan requirements (when applicable).

Special Provision to Item 502
Barricades, Signs and Traffic Handling

Item 502, "Barricades, Signs and Traffic Handling" of the Standard Specifications, is hereby amended with respect to the clauses cited below, and no other clauses or requirements of this Item are waived or changed hereby.

Article 502.1., "Description," is supplemented by the following:

Temporary work-zone (TWZ) traffic control devices manufactured after December 31, 2019, must have been successfully tested to the crashworthiness requirements of the 2016 edition of the Manual for Assessing Safety Hardware (MASH). Such devices manufactured on or before this date and successfully tested to NCHRP Report 350 or the 2009 edition of MASH may continue to be used throughout their normal service lives. An exception to the manufacture date applies when, based on the project's date of letting, a category of MASH-2016 compliant TWZ traffic control devices are not approved, or are not self-certified after the December 31, 2019, date. In such case, devices that meet NCHRP-350 or MASH-2009 may be used regardless of the manufacture date.

Such TWZ traffic control devices include: portable sign supports, barricades, portable traffic barriers designated exclusively for use in temporary work zones, crash cushions designated exclusively for use in temporary work zones, longitudinal channelizers, truck and trailer mounted attenuators. Category I Devices (i.e., lightweight devices) such as cones, tubular markers and drums without lights or signs attached however, may be self-certified by the vendor or provider, with documentation provided to Department or as are shown on Department's Compliant Work Zone Traffic Control Device List.

Article 502.4., "Payment," is supplemented by the following:

Truck mounted attenuators and trailer attenuators will be paid for under Special Specification, "Truck Mounted Attenuator (TMA) and Trailer Attenuator (TA)." Portable Changeable Message Signs will be paid for under Special Specification, "Portable Changeable Message Sign." Portable Traffic Signals will be paid for under Special Specification, "Portable Traffic Signals."

Special Provision to Item 506

Temporary Erosion, Sedimentation, and Environmental Controls

Item 506, "Temporary Erosion, Sedimentation, and Environmental Controls," of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Article 506.1., "Description." The second paragraph is voided and replaced by the following.

Contractor is considered primary operator to have day-to-day operational control as defined in TPDES GP TXR150000.

1.1. For projects with soil disturbance of less than 1 acre, no submittal to TCEQ will be required but Contractor will follow SWP3. For projects with soil disturbance of 1acre to less than 5 acres a small site notice will be posted at the site. For projects with soil disturbance of 5 acres or more a Notice of Intent (NOI) is required and a large site notice posted at site. Postings will be in accordance with TPDES GP TXR150000. Postings not associated with project specific locations will be in same location as Department's postings.

1.2. Notice of Intent (NOI). Submit a NOI, if applicable, with the TCEQ under the TPDES GP TXR150000 at least 7 days prior to commencement of construction activities at the project site. Provide a signed copy to the Engineer and any other MS4 operators at the time of submittal. The Department will submit their NOI prior to contractor submission and will provide a copy for Contractor's use in completing the Contractor's NOI form.

1.3. Notice of Change (NOC). Upon concurrence of the Engineer, submit a NOC, if applicable, to the TCEQ within 14 days of discovery of a change or revision to the NOI as required by the TPDES GP TXR150000. Provide a signed copy of the NOC to the Engineer and any other MS4 operators at the time of submittal.

1.4. Notice of Termination (NOT). Upon concurrence of the Engineer, submit a NOT, if applicable, to the TCEQ within 30 days of the Engineer's approval that 70% native background vegetative cover is met or equivalent permanent stabilization have been employed in accordance with the TPDES GP TXR 150000. Provide a signed copy of the NOT to the Engineer and any other MS4 operators at the time of submittal.

Section 506.3.1, "Contractor Responsible Person Environmental (CRPE) Qualifications and Responsibilities," is supplemented by the following:

3.1. Contractor Responsible Person Environmental (CRPE) Qualifications and Responsibilities. Provide and designate in writing at the preconstruction conference a CRPE and alternate CRPE who have overall responsibility for the storm water management program. The CRPE will implement stormwater and erosion control practices; will oversee and observe stormwater control measure monitoring and management; will monitor the project site daily and produce daily monitoring reports as long as there are BMPs in place or soil disturbing activities are evident to ensure compliance with the SWP3 and TPDES General Permit TXR150000. Daily monitor reports shall be maintained and made available upon request. During time suspensions when work is not occurring or on contract non-work days, daily inspections are not required unless a rain event has occurred. The CRPE will provide recommendations on how to improve the effectiveness of control measures. Attend the Department's preconstruction conference for the project. Ensure training is completed as identified in Section 506.3.3., "Training," by all applicable personnel before employees work on the project. Document and maintain and make available upon request, a list, signed by the CRPE, of all applicable Contractor and subcontractor employees who have completed the training. Include the employee's name, the training course name, and date the employee completed the training.

Section 506.3.3., "Training," is supplemented by the following:

Training is provided by the Department at no cost to the Contractor and is valid for 3 yr. from the date of completion. The Engineer may require the following training at a frequency less than 3 yr. based on environmental needs:

- "Environmental Management System: Awareness Training for the Contractor" (English and Spanish) (Approximate running time 20 min.), and
- "Storm Water: Environmental Requirements During Construction" (English and Spanish) (Approximate running time 20 min.).

The Contractor responsible person environmental (CRPE), alternate CRPE designated for emergencies, Contractor's superintendent, Contractor, and subcontractor lead personnel involved in soil disturbing or SWP3 activities must enroll in and complete the training listed below and maintain and make available upon request the certificate of completion. Training is provided by a third party and is valid for 3 yr. from the date shown on the Certificate of Completion. Coordinate enrollment as prescribed by the Department and pay associated fees for the following training:

- "Revegetation During Construction,"
- "Construction General Permit Compliance," and
- "Construction Stage Gate Checklist (CSGC)."

Training and associated fee will not be measured or paid for directly but are subsidiary to this Item.

Special Provision to Item 520
Weighing and Measuring Equipment

Item 520, "Weighing and Measuring Equipment" of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Article 520.2., "Equipment." The third paragraph is voided and replaced by the following.

Calibrate truck scales using weights certified by the Texas Department of Agriculture (TDA) or an equivalent agency as approved. Provide a written calibration report from a scale mechanic for truck scale calibrations. Cease plant operations during the checking operation. Do not use inaccurate or inadequate scales. Bring performance errors as close to zero as practicable when adjusting equipment.

Article 520.2., "Equipment." The fourth paragraph is amended to include the following:

At the Contractors option, an electronic ticket delivery system (e-ticketing) may be used instead of printed tickets. The use of e-ticketing will require written approval of the Engineer. At a minimum, the approved system will:

- Provide electronic, real-time e-tickets meeting the requirements of the applicable bid items;
- Automatically generate e-tickets using software and hardware fully integrated with the automated scale system used to weigh the material, and be designed in such a way that data input cannot be altered by the Contractor or the Engineer;
- Provide the Engineer access to the e-ticketing data in real-time with a web-based or app-based system compatible with iOS;
- Provide offline capabilities to prevent data loss if power or connectivity is lost;
- Require both the Contractor and the Engineer to accept or reject the e-ticket and provide the ability to record the information required by the applicable bid items, as well as any comments. Record the time of the approval/rejection and include it in the summary spreadsheet described below. Provide each party the capability to edit their respective actions and any entered information;

The Contractor may discontinue use of the e-ticket system and provide printed tickets as needed to meet the requirements of the applicable bid items.

Special Provision to Item 540
Metal Beam Guard Fence

Item 540, "Metal Beam Guard Fence" of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Article 540.4.7, "Measurement," is voided and replaced with the following:

> **Long Span System**. Measurement will be by each long span system, complete in place. Each long span system will be from the first CRT to the last CRT in the system.

Special Provision to Item 636
Signs

Item 636, "Signs" of the Standard Specifications, is hereby amended with respect to the clauses cited below, and no other clauses or requirements of this Item are waived or changed hereby.

Section 636.3.1, "Fabrication." is deleted.

Section 636.3.1.2, "Sheeting Application." The last sentence of the fourth paragraph is voided and replaced by the following.

Do not splice sheeting or overlay films for signs fabricated with ink or with colored transparent films.

Special Provision to Item 643
Sign Identification Decals

Item 643, "Sign Identification Decals," of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Article 2. "Materials." The sign identification decal design shown in Figure 1 and the description for each row in Table 1 are supplemented by the following.

Texas Department of Transportation												
C	**Fabrication Date**										**T**	**1**
J	F	M	A	M	J	J	A	S	O	N	D	**2**
	201		202		203		204		205			**3**
	0	1	2	3	4	5	6	7	8	9		**4**
Sheeting MFR - Substrate												
A	B	C	D	E	F	G	H	J	K	L	M	**5**
Film MFR												
A	B	C	D	E	F	G	H	J	K	L	M	**6**
Sheeting MFR - Legend												
A	B	C	D	E	F	G	H	J	K	L	M	**7**
Installation Date												
				0	1	2	3					**8**
	0	1	2	3	4	5	6	7	8	9		**9**
J	F	M	A	M	J	J	A	S	O	N	D	**10**
	201		202		203		204		205			**11**
	0	1	2	3	4	5	6	7	8	9		**12**
Name of Sign Fabricator **Physical Address** **City, State, Zip Code**												**13**

Figure 1
Decal Design (Row numbers explained in Table 1)

Table 1
Decal Description

Row Explanation
1 – Sign fabricator
2 – Month fabricated
3 – First 3 digits of year fabricated
4 – Last digit of year fabricated
5 – Manufacturer of the sheeting applied to the substrate
6 – Film (colored transparent or non-reflective black) manufacturer
7 – Manufacturer of the sheeting for the legend
8 – Tens digit of date installed
9 - Ones digit of date installed
10 – Month installed
11 – First 3 digits of year installed
12 – Last digit of year installed
13 – Name of sign fabricator and physical location of sign shop

Special Provision to Item 654
Sign Walkways

Item 654," Sign Walkways" of the Standard Specifications, is hereby amended with respect to the clauses cited below, and no other clauses or requirements of this Item are waived or changed hereby.

Section 654.3.2, "Fabrication." The following language is added after the first paragraph.

Fabrication plants that produce sign walkways must be approved in accordance with DMS-7380, "Steel Non-Bridge Member Fabrication Plant Qualification." The Construction Division maintains a list of approved sign walkway fabrication plants on the Department's Material Producers List.

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Special Provision to Item 656
Foundations for Traffic Control Devices

Item 656, "Foundations for Traffic Control Devices" of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Article 3. "Construction.," the first paragraph is supplemented by the following:

Ensure the top of the foundation and anchor bolts meet specified requirements in relation to the final grade.

Special Provision to Item 666
Retroreflectorized Pavement Markings

Item 666, "Retroreflectorized Pavement Markings," of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Section 2.3., "Glass Traffic Beads." The first paragraph is voided and replaced by the following:

Furnish drop-on glass beads in accordance with DMS-8290, "Glass Traffic Beads," or as approved. Furnish a double-drop of Type II and Type III drop-on glass beads for longitudinal pavement markings where each type bead is applied separately in equal portions (by weight), unless otherwise approved. Apply the Type III beads before applying the Type II beads. Furnish Type II beads for work zone pavement markings and transverse markings or symbols.

Section 4.3.1., "Type I Markings.," is supplemented by the following:

4.3.1.3. Spot Striping. Perform spot striping on a callout basis with a minimum callout quantity as shown on the plans.

Section 4.3.2., "Type II Markings.," is supplemented by the following:

4.3.2.1. Spot Striping. Perform spot striping on a callout basis with a minimum callout quantity as shown on the plans.

Section 4.4., "Retroreflectivity Requirements.," is voided and replaced by the following.

Type I markings for Contracts totaling more than 20,000 ft. of pavement markings must meet the following minimum retroreflectivity values for all longitudinal edgeline, centerline or no passing barrier-line, and lane line markings when measured any time after 3 days, but not later than 10 days after application.

- White markings: 250 millicandelas per square meter per lux (mcd/m^2/lx)
- Yellow markings: 175 mcd/m^2/lx

Retroreflectivity requirements for Type I markings are not required for Contracts with less than 20,000 ft. of pavement markings or Contracts with callout work, unless otherwise shown on the plans.

Section 4.5., "Retroreflectivity Measurements.," is voided and replaced by the following:

Use a mobile retroreflectometer to measure retroreflectivity for Contracts totaling more than 50,000 ft. of pavement markings, unless otherwise shown on the plans. For Contracts with less than 50,000 ft. of pavement markings, mobile or portable retroreflectometers may be used at the Contractor's discretion. Coordinate with and obtain authorization from the Engineer before starting any retroreflectivity data collection.

Section 4.5.1., "Mobile Retroreflectometer Measurements." The last paragraph is voided and replaced by the following.

Restripe again at the Contractor's expense with a minimum of 0.060 in. (60 mils) of Type I marking material if the average of these measurements falls below the minimum retroreflectivity requirements. Take measurements every 0.1 miles a minimum of 10 days after this third application within that mile segment for that series of markings. If the markings do not meet minimum retroreflectivity after this third application, the Engineer may require removal of all existing markings, a new application as initially specified, and a repeat of the application process until minimum retroreflectivity requirements are met.

Section 4.5.2., "Portable Retroreflectometer Measurements." The first and second paragraphs are voided and replaced by the following.

Provide portable measurement averages for every 1.0 mile unless otherwise specified or approved. Take a minimum of 20 measurements for each 1-mi. section of roadway for each series of markings (e.g., edgeline, center skip line, each line of a double line) and direction of traffic flow when using a portable reflectometer. Measure each line in both directions for centerlines on two-way roadways (i.e., measure both double solid lines in both directions and measure all center skip lines in both directions). The spacing between each measurement must be at least 100 ft. The Engineer may decrease the mileage frequency for measurements if the previous measurements provide satisfactory results. The Engineer may require the original number of measurements if concerns arise.

Restripe at the Contractor's expense with a minimum of 0.060 in. (60 mils) of Type I marking material if the averages of these measurements fail. Take a minimum of 10 more measurements after 10 days of this second application within that mile segment for that series of markings. Restripe again at the Contractor's expense with a minimum of 0.060 in. (60 mils) of Type I marking material if the average of these measurements falls below the minimum retroreflectivity requirements. If the markings do not meet minimum retroreflectivity after this third application, the Engineer may require removal of all existing markings, a new application as initially specified, and a repeat of the application process until minimum retroreflectivity requirements are met.

Section 4.6. "Performance Period." The first sentence is voided and replaced by the following:

All longitudinal markings must meet the minimum retroreflectivity requirements within the time frame specified. All markings must meet all other performance requirements of this specification for at least 30 calendar days after installation.

Article 6. "Payment." The first two paragraphs are voided and replaced by the following.

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Pavement Sealer" of the size specified; "Retroreflectorized Pavement Markings" of the type and color specified and the shape, width, size, and thickness (Type I markings only) specified, as applicable; "Retroreflectorized Pavement Markings with Retroreflective Requirements" of the types, colors, sizes, widths, and thicknesses specified; "Retroreflectorized Profile Pavement Markings" of the various types, colors, shapes, sizes, and widths specified; or "Reflectorized Pavement Marking (Call Out)" of the shape, width, size, and thickness (Type I markings only) specified, as applicable; or "Pavement Sealer (Call Out)" of the size specified.

This price is full compensation for materials, application of pavement markings, equipment, labor, tools, and incidentals.

Special Provision to Special Specification 6010
Closed Circuit Television (CCTV) Field Equipment

Special Specification 6010 "Closed Circuit Television (CCTV) Field Equipment," is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Section 6010.2.1, "General Requirements." The third paragraph is voided and replaced by the following:

CCTV field equipment to include the following:

- color video camera units,
- camera lenses, filters, control circuits and accessories,
- camera housing,
- medium duty pan and tilt units with click and drag position control,
- video and camera control and power cable connectors and assemblies,
- video, data, and power surge suppression, and
- built-in ID generator.

Section 6010.2.2., "Functional Requirements for Analog CCTV." All paragraphs are voided and not replaced.

Section 6010.2.3.1.3., "Resolution." The first paragraph is voided and replaced by the following:

Support the following resolutions:

- 720p (1280 x 720 pixel array),
- 1080p (1920 x 1080 pixel array),
- D1 (720 x 480 pixel array),
- CIF (352 x 240 pixel array), and
- VGA (640 x 480 pixel array) at a minimum dependent on video stream configuration.

Section 6010.2.3.1.6., "Video Stream Format." The first paragraph is voided and replaced by the following:

Allow simultaneous encoding and transmission, of a minimum, two configurable digital video streams in conformance with the Moving Picture Experts Group's MPEG-4 part 10 (H.264). Support configuration of the following at a minimum:

- H.264,
- H.265, and
- H.264 + H.264.

Section 6010.2.3.1.8., "Aspect Ratio." The first paragraph is voided and replaced by the following:

Support width to height aspect ratio of 16:9.

Section 6010.2.3.2., "Lens." The first paragraph is voided and replaced by the following:

Provide an integral lens assembly for each camera with the following features:

- an f/1.6 or better glass multi-coated zoom lens with variable focal lengths with a minimum 30X zoom range,
- 12X auto and manual digital zoom minimum, and
- automatic and manual focus and iris control.

Section 6010.2.3.3., "Network Interface Requirements." The third paragraph is voided and replaced by the following:

Support, at a minimum, RTP, RTSP, UDP/IP, TCP/IP, IPv4, HTTP, IGMPv2, DHCP, NTP, IEEE 802.1x, Ethernet 802.3u, SNMP, RADIUS Key, and Telnet.

Section 6010.2.4.1., "Serial." The first paragraph is voided and not replaced.

Section 6010.2.4.2., "Video." The first paragraph is voided and not replaced.

Section 6010.2.4.3., "Ethernet." The first paragraph is voided and replaced by the following:

Provide a shielded twisted pair (STP) Category 6 (or equivalent) at a minimum rated for outdoor use in conformance to TIA/EIA 568B Standard. Cable must not exceed an attenuation of 30 dB per 300 ft. of cable at 100 MHz.

Section 6010.2.5., "Video Encoding Interoperability." The first paragraph is voided and replaced by the following:

Video encoding and decoding equipment may be achieved through software or hardware means. Ensure camera's encoded video is interoperable with hardware and software decoders from other manufacturers. Ensure the camera's encoded video can be decoded by a minimum of two other manufacturer's software or hardware decoders that are currently in use by the Department. Contact the Department for decoders supported prior to procurement of camera unit.

Section 6010.2.6., "Camera Housing." The second paragraph is voided and replaced by the following:

Provide camera housing with a sunshield to reduce the solar heating of the camera. The total weight of the camera (including housing, sunshield, and all internal components) must not exceed 25 lb.

Section 6010.2.9., "Control Receivers." All paragraphs are voided and not replaced.

Section 6010.3.8.1.4.4., "Communication." The first paragraph is voided and replaced by the following:

For digital camera models, document network connection to the camera through ping or telnet session from a remote PC.

Special Provision to Special Specification 6064
Intelligent Transportation System (ITS) Pole with Cabinet

Special Specification 6064, "Intelligent Transportation System (ITS) Pole with Cabinet" is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Section 6064.3.1., "Anchor Bolts." The second sentence is voided and replaced with the following:

Galvanize these items in accordance with Item 445, "Galvanizing."

Section 6064.3.2., "ITS Poles." Voided and replaced with the following:

ITS Poles. Fabricate ITS poles in accordance with the details shown on the plans, this Item, and Item 441, "Steel Structures." Alternate designs are not acceptable unless approved by the Department.

Provide properly fitting components. Provide round, octagonal (8-sided), or dodecagonal (12-sided) pole shafts tapered to the heights shown on the plans.

Permanently mark, at a visible location when erected, ITS pole base plates with the design wind speed. Locate the handholes, as shown on the plans, opposite of the direction of traffic flow.

Permanently mark, at a visible location when erected, ITS pole base plates with the fabrication plant's insignia. Place the mark on the pole base plate adjacent to the handhole access compartment.

Provide circumferential welds only at the ends of the shaft. Provide no more than two longitudinal seam welds in shaft sections. Provide 100% penetration within 6 in. of circumferential base welds and 60% minimum penetration at other locations along the longitudinal seam welds, unless otherwise specified. Use a welding technique that minimizes acid entrapment during later galvanizing. Hot-dip galvanize all fabricated parts in accordance with Item 445, "Galvanizing."

Perform at least 10% ultrasonic testing (UT) of longitudinal seam welds on the pole shafts. Use a Department approved UT procedure to ensure 60% or 85% minimum penetration where specified. Perform testing at a minimum of three locations on each shaft section (at both ends and middle). The minimum length of each test area must be 10 in. If minimum penetration is not achieved in any of the tested areas, test an additional 24 in. beyond the originally selected test areas requiring 60% or 85% penetration. Test the entire shaft seam weld if any locations within the additional 24 in. test areas does not achieve 60% or 85% penetration. Repair the deficient areas with a Department approved repair procedure and retest.

Fabricate air terminal and bracket assembly to serve as a lightning arrestor in accordance with ITS pole air terminal details and IEEE standards for lightning protection. Bond air terminal with air terminal bracket via clad weld or other approved bolted connection.

Special Provision to Special Specification 6185
Truck Mounted Attenuator (TMA) and Trailer Attenuator (TA)

Item 6185, "Truck Mounted Attenuator (TMA) and Trailer Attenuator (TA)" of the Standard Specifications, is hereby amended with respect to the clauses cited below, and no other clauses or requirements of this Item are waived or changed hereby.

Article 4. "Measurement", is voided and replaced by the following:

4.1. **Truck Mounted Attenuator/Trailer Attenuator (Stationary).** This Item will be measured by the day. TMA/TAs must be set up in a work area and operational before a calendar day can be considered measureable. A day will be measured for each TMA/TA set up and operational on the worksite.

4.2. **Truck Mounted Attenuator/Trailer Attenuator (Mobile Operation).** This Item will be measured by the hour or by the day. The time begins once the TMA/TA is ready for operation at the predetermined site and stops when notified by the Engineer. When measurement by the hour is specified, a minimum of 4 hr. will be paid each day for each operating TMA/TA used in a mobile operation. When measurement by the day is specified, a day will be measured for each TMA/TA set up and operational on the worksite.

Special Provision to Special Specification 6407
Full Color LED Variable Message Sign System

Special Specification 6407 "Full Color LED Variable Message Sign System" is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Section 6407.2.2.1.2., "Lift-Face Housing." All paragraphs are voided and replaced by the following:

Housing. The variable message sign (VMS) housing dimensions must be a maximum of 8 ft. (h) x 16 ft. (w) × 18 in. (d). The maximum weight of the sign must be 1500 lbs. Internal access to the sign components must be from the front of the VMS and provided by either a single lift-face panel or by multiple vertically-hinged rigid door panels that extend the full height of the display matrix. No exposed fasteners or welds will be allowed on the housing face.

The door panel option must have retaining latch mechanisms to hold each door open at a 90° angle. The lift-face option must have two fixed-force gas springs to hold the panel open at 60° from vertical. The single lift-face panel or each individual door panel must be secured in the closed position with a minimum of two captive-type latches that compress a gasket located around the perimeter of the panel to prevent water entry.

Design the sign and attached support elements to withstand design wind loads without permanent deformation. All sign types and attached support elements must be designed to withstand a 3-sec. gust basic wind speed of 140 mph, a gust factor of 1.14, and the AASHTO specified wind importance factor for the 50-yr. mean recurrence interval for non-hurricane regions of 1.0 (in accordance with the AASHTO *Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals,* 6th Edition (2013.)) Front face must have black finish with an outdoor service life of 20 yr. Sign face must provide a high-contrast appearance for the display. Mask (if used) must contain an opening for each pixel.

The housing must provide safe and convenient access to all modular assemblies, components, wiring, and subsystems located within the VMS. All internal components must be removable and replaceable by a single technician.

VMS front face borders (top, bottom, left side, and right side) which surround the LED display matrix panels must be painted black to maximize display contrast and legibility.

The equipment within the sign housing must be protected from moisture, dust, dirt, and corrosion and must meet NEMA 3R enclosure criteria as defined in NEMA Standards Publication 250, "Enclosures for Electrical Equipment (1000 V Maximum.)".

The floor of the housing must have a minimum of four drain holes, with snap-in, drain filter plug inserts, in each section formed by internal structural members. Water drain filter plug inserts must be replaceable. Weep holes and ventilation or exhaust hoods must be screened to prevent the entrance of insects and small animals.

Section 6407.2.3.8., "Power." The first paragraph is voided and replaced by the following:

Power. The VMS and its controller must be capable of operating at 120/240 VAC, 30A per leg maximum load, 60 Hz, single phase power. The VMS controller cabinet must be capable of distributing power to 2 separate VMS's.

Section 6407.3.5., "Maintenance." All paragraphs are voided and not replaced.

Section 6407.3.7., "Warranty." All paragraphs are voided and replaced by the following:

Warranty. Ensure that the installed color VMS has a manufacturer's warranty. Materials and parts must be warranted for a minimum of 5 yr. from accepted installation date. The accepted installation date is defined as the date that the Department

determines that the sign has passed all testing requirements. The warranty will cover all defects in material, parts, design, and workmanship, including remote diagnostics. The vendor must submit the terms of warranty in writing.

Special Specification 3096
Asphalts, Oils, and Emulsions

1. DESCRIPTION

Provide asphalt cements, cutback and emulsified asphalts, performance-graded asphalt binders, and other miscellaneous asphalt materials as specified on the plans.

2. MATERIALS

Provide asphalt materials that meet the stated requirements when tested in conformance with the referenced Department, AASHTO, and ASTM test methods. Use asphalt containing recycled materials only if the recycled components meet the requirements of Article 6.9., "Recycled Materials." Provide asphalt materials that the Department has preapproved for use in accordance with Tex-545-C, "Asphalt Binder Quality Program."

Inform the Department of all additives or modifiers included in the asphalt binder as part of the facility quality plan, as required by Tex-545-C, "Asphalt Binder Quality Program," and provide that information to Department personnel. The Department reserves the right to prohibit the use of any asphalt additive or modifier.

Limit the use of polyphosphoric acid to no more than 0.5% by weight of the asphalt binder.

The use of re-refined engine oil bottoms is prohibited.

Acronyms used in this Item are defined in Table 1.

Table1
Acronyms

Acronym	Definition
Test Procedure Designations	
Tex	Department
T or R	AASHTO
D	ASTM
Polymer Modifier Designations	
P	polymer-modified
SBR or L	styrene-butadiene rubber (latex)
SBS	styrene-butadiene-styrene block co-polymer
TR	tire rubber (from ambient temperature grinding of truck and passenger tires)
AC	asphalt cement
AE	asphalt emulsion
AE-P	asphalt emulsion prime
A-R	asphalt-rubber
C	cationic
EAP&T	emulsified asphalt prime and tack
EBL	emulsified bonding layer
FDR	full depth reclamation
H-suffix	harder residue (lower penetration)
HF	high float
HY	high yield
MC	medium-curing
MS	medium-setting
PCE	prime, cure, and erosion control
PG	performance grade
RC	rapid-curing
RS	rapid-setting
S-suffix	stockpile usage
SCM	special cutback material
SS	slow-setting
SY	standard yield
TRAIL	tracking resistant asphalt interlayer

2.1. **Asphalt Cement**. Provide asphalt cement that is homogeneous, water-free, and nonfoaming when heated to 347°F, and meets the requirements in Table 2.

Table 2
Asphalt Cement

Property	Test Procedure	Viscosity Grade									
		AC-0.6		AC-1.5		AC-3		AC-5		AC-10	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Viscosity	T 202										
140°F, poise		40	80	100	200	250	350	400	600	800	1,200
275°F, poise		0.4	–	0.7	–	1.1	–	1.4	–	1.9	–
Penetration, 77°F, 100g, 5 sec.	T 49	350	–	250	–	210	–	135	–	85	–
Flash point, C.O.C., °F	T 48	425	–	425	–	425	–	425	–	450	–
Solubility in trichloroethylene, %	T 44	99.0	–	99.0	–	99.0	–	99.0	–	99.0	–
Spot test	Tex-509-C	Neg.		Neg.		Neg.		Neg.		Neg.	
Tests on residue from RTFOT:	T 240										
Viscosity, 140°F, poise	T 202	–	180	–	450	–	900	–	1,500	–	3,000
Ductility,[1] 77°F 5 cm/min., cm	T 51	100	–	100	–	100	–	100	–	100	–

1. If AC-0.6 or AC-1.5 ductility at 77°F is less than 100 cm, material is acceptable if ductility at 60°F is more than 100 cm.

2.2. **Polymer-Modified Asphalt Cement**. Provide polymer-modified asphalt cement that is smooth, homogeneous, and meets the requirements Table 3. Supply samples of the base asphalt cement and polymer additives if requested.

Table 3
Polymer-Modified Asphalt Cement

Property	Test Procedure	Polymer-Modified Viscosity Grade											
		AC-12-5TR		NT-HA[1]		AC-15P		AC-20XP		AC-10-2TR		AC-20-5TR	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Polymer		TR		–		SBS		SBS		TR		TR	
Polymer content, % (solids basis)	Tex-533-C or Tex-553-C	5.0	–	–	–	3.0	–	–	–	2.0	–	5.0	–
Dynamic shear, G*/sinδ, 82°C, 10 rad/s, kPa	T 315			1.0	–								
Dynamic shear, G*/sinδ, 64°C, 10 rad/s, kPa	T 315	–	–	–	–	–	–	1.0	–	–	–	1.0	–
Dynamic shear, G*/sinδ, 58°C, 10 rad/s, kPa	T 315	1.0	–	–	–	–	–	–	–	1.0	–	–	–
Viscosity 140°F, poise 275°F, poise	 T 202 T 202	 1,200	 –	 –	 4,000	 1,500 –	 – 8.0	 2,000 –	 – –	 1,000 –	 – 8.0	 2,000 –	 – 10.0
Penetration, 77°F, 100 g, 5 sec.	T 49	110	150	–	25	100	150	75	115	95	130	75	115
Ductility, 5cm/min., 39.2°F, cm	T 51					–	–	–	–	–	–	–	–
Elastic recovery, 50°F, %	Tex-539-C	55	–			55	–	55	–	30	–	55	–
Softening point, °F	T 53	113	–	170	–	–	–	120	–	110	–	120	–
Polymer separation, 5 hr.	Tex-540-C	None				None		None		None		None	
Flash point, C.O.C., °F	T 48	425	–	425	–	425	–	425	–	425	–	425	–
Tests on residue from RTFOT aging and pressure aging:	T 240 and R 28												
Creep stiffness S, -18°C, MPa m-value, -18°C	T 313	 – 0.300	 300 –	 – –	 – –	 – 0.300	 300 –	 – 0.300	 300 –	 – 0.300	 300 –	 – 0.300	 300 –

1. Non-Tracking Hot Applied Tack Coat - TRAIL product

2.3. **Cutback Asphalt**. Provide cutback asphalt that meets the requirements of Tables 4, 5, and 6, for the specified type and grade. Supply samples of the base asphalt cement and polymer additives if requested.

Table 4
Rapid-Curing Cutback Asphalt

Property	Test Procedure	Type–Grade					
		RC-250		RC-800		RC-3000	
		Min	Max	Min	Max	Min	Max
Kinematic viscosity, 140°F, cSt	T 201	250	400	800	1,600	3,000	6,000
Water, %	D95	–	0.2	–	0.2	–	0.2
Flash point, T.O.C., °F	T 79	80	–	80	–	80	–
Distillation test:	T 78						
Distillate, percentage by volume of total distillate to 680°F							
to 437°F		40	75	35	70	20	55
to 500°F		65	90	55	85	45	75
to 600°F		85	–	80	–	70	–
Residue from distillation, volume %		70	–	75	–	82	–
Tests on distillation residue:							
Viscosity, 140°F, poise	T 202	600	2,400	600	2,400	600	2,400
Ductility, 5 cm/min., 77°F, cm	T 51	100	–	100	–	100	–
Solubility in trichloroethylene, %	T 44	99.0	–	99.0	–	99.0	–
Spot test	Tex-509-C	Neg.		Neg.		Neg.	

Table 5
Medium-Curing Cutback Asphalt

Property	Test Procedure	Type–Grade							
		MC-30		MC-250		MC-800		MC-3000	
		Min	Max	Min	Max	Min	Max	Min	Max
Kinematic viscosity, 140°F, cSt	T 201	30	60	250	500	800	1,600	3,000	6,000
Water, %	D95	–	0.2	–	0.2	–	0.2	–	0.2
Flash point, T.O.C., °F	T 79	95	–	122	–	140	–	149	–
Distillation test:	T 78								
Distillate, percentage by volume of total distillate to 680°F									
to 437°F		–	35	–	20	–	–	–	–
to 500°F		30	75	5	55	–	40	–	15
to 600°F		75	95	60	90	45	85	15	75
Residue from distillation, volume %		50	–	67	–	75	–	80	–
Tests on distillation residue:									
Viscosity, 140°F, poise	T 202	300	1,200	300	1,200	300	1,200	300	1,200
Ductility, 5 cm/min., 77°F, cm	T 51	100	–	100	–	100	–	100	–
Solubility in trichloroethylene, %	T 44	99.0	–	99.0	–	99.0	–	99.0	–
Spot test	Tex-509-C	Neg.		Neg.		Neg.		Neg.	

Table 6
Special-Use Cutback Asphalt

Property	Test Procedure	Type–Grade					
		MC-2400L		SCM I		SCM II	
		Min	Max	Min	Max	Min	Max
Kinematic viscosity, 140°F, cSt	T 201	2,400	4,800	500	1,000	1,000	2,000
Water, %	D95	–	0.2	–	0.2	–	0.2
Flash point, T.O.C., °F	T 79	150	–	175	–	175	–
Distillation test:	T 78						
Distillate, percentage by volume of total distillate to 680°F							
to 437°F		–	–	–	–	–	–
to 500°F		–	35	–	0.5	–	0.5
to 600°F		35	80	20	60	15	50
Residue from distillation, volume %		78	–	76	–	82	–
Tests on distillation residue:							
Polymer		SBR		–		–	
Polymer content, % (solids basis)	Tex-533-C	2.0	–	–	–	–	–
Penetration, 100 g, 5 sec., 77°F	T 49	150	300	180	–	180	–
Ductility, 5 cm/min., 39.2°F, cm	T 51	50	–	–	–	–	–
Solubility in trichloroethylene, %	T 44	99.0	–	99.0	–	99.0	–

2.4. **Emulsified Asphalt**. Provide emulsified asphalt that is homogeneous, does not separate after thorough mixing, and meets the requirements for the specified type and grade in Tables 7, 8, 9, 10, and 10A-C.

Table 7
Emulsified Asphalt

Property	Test Procedure	Type–Grade									
		Rapid-Setting		Medium-Setting				Slow-Setting			
		HFRS-2		MS-2		AES-300		SS-1		SS-1H	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Viscosity, Saybolt Furol	T 72										
77°F, sec.		–	–	–	–	75	400	20	100	20	100
122°F, sec.		150	400	100	300	–	–	–	–	–	–
Sieve test, %	T 59	–	0.1	–	0.1	–	0.1	–	0.1	–	0.1
Miscibility	T 59	–		–		–		Pass		Pass	
Cement mixing, %	T 59	–	–	–	–	–	–	–	2.0	–	2.0
Coating ability and water resistance:	T 59										
Dry aggregate/after spray		–		–		Good/Fair		–		–	
Wet aggregate/after spray		–		–		Fair/Fair		–		–	
Demulsibility, 35 mL of 0.02 N $CaCl_2$, %	T 59	50	–	–	30	–	–	–	–	–	–
Storage stability, 1 day, %	T 59	–	1	–	1	–	1	–	1	–	1
Freezing test, 3 cycles[1]	T 59	–		Pass		–		Pass		Pass	
Distillation test:	T 59										
Residue by distillation, % by wt.		65	–	65	–	65	–	60	–	60	–
Oil distillate, % by volume of emulsion		–	0.5	–	0.5	–	5	–	0.5	–	0.5
Tests on residue from distillation:											
Penetration, 77°F, 100 g, 5 sec.	T 49	100	140	120	160	300	–	120	160	70	100
Solubility in trichloroethylene, %	T 44	97.5	–	97.5	–	97.5	–	97.5	–	97.5	–
Ductility, 77°F, 5 cm/min., cm	T 51	100	–	100	–	–	–	100	–	80	–
Float test, 140°F, sec.	T 50	1,200	–	–	–	1,200	–	–	–	–	–

1. Applies only when the Engineer designates material for winter use.

Table 8
Cationic Emulsified Asphalt

Property	Test Procedure	Type–Grade											
		Rapid-Setting				Medium-Setting				Slow-Setting			
		CRS-2		CRS-2H		CMS-2		CMS-2S		CSS-1		CSS-1H	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Viscosity, Saybolt Furol	T 72												
77°F, sec.		–	–	–	–	–	–	–	–	20	100	20	100
122°F, sec.		150	400	150	400	100	300	100	300	–	–	–	–
Sieve test, %	T 59	–	0.1	–	0.1	–	0.1	–	0.1	–	0.1	–	0.1
Cement mixing, %	T 59	–	–	–	–	–	–	–	–	–	2.0	–	2.0
Coating ability and water resistance:	T 59												
Dry aggregate/after spray		–		–		Good/Fair		Good/Fair		–		–	
Wet aggregate/after spray		–		–		Fair/Fair		Fair/Fair		–		–	
Demulsibility, 35 mL of 0.8% Sodium dioctyl sulfosuccinate, %	T 59	70	–	70	–	–	–	–	–	–	–	–	–
Storage stability, 1 day, %	T 59	–	1	–	1	–	1	–	1	–	1	–	1
Particle charge	T 59	Positive		Positive		Positive		Positive		Positive		Positive	
Distillation test:													
Residue by distillation, % by wt.	T 59	65	–	65	–	65	–	65	–	60	–	60	–
Oil distillate, % by volume of emulsion		–	0.5	–	0.5	–	7	–	5	–	0.5	–	0.5
Tests on residue from distillation:													
Penetration, 77°F, 100 g, 5 sec.	T 49	120	160	70	110	120	200	300	–	120	160	70	110
Solubility in trichloroethylene, %	T 44	97.5	–	97.5	–	97.5	–	97.5	–	97.5	–	97.5	–
Ductility, 77°F, 5 cm/min., cm	T 51	100	–	80	–	100	–		–	100	–	80	–

Table 9
Polymer-Modified Emulsified Asphalt

Property	Test Procedure	Type–Grade									
		Rapid-Setting		Medium-Setting				Slow-Setting			
		HFRS-2P		AES-150P		AES-300P		AES-300S		SS-1P	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Viscosity, Saybolt Furol	T 72										
77°F, sec.		–	–	75	400	75	400	75	400	30	100
122°F, sec.		150	400					–	–	–	–
Sieve test, %	T 59	–	0.1	–	0.1	–	0.1	–	0.1	–	0.1
Miscibility	T 59	–		–		–		–		Pass	
Coating ability and water resistance:											
Dry aggregate/after spray	T 59	–		Good/Fair		Good/Fair		Good/Fair		–	
Wet aggregate/after spray		–		Fair/Fair		Fair/Fair		Fair/Fair		–	
Demulsibility, 35 mL of 0.02 N $CaCl_2$, %	T 59	50	–	–	–	–	–	–	–	–	–
Storage stability, 1 day, %	T 59	–	1	–	1	–	1	–	1	–	1
Breaking index, g	Tex-542-C	–	–								
Distillation test:[1]	T 59										
Residue by distillation, % by wt.		65	–	65	–	65	–	65	–	60	–
Oil distillate, % by volume of emulsion		–	0.5	–	3	–	5	–	7	–	0.5
Tests on residue from distillation:											
Polymer content, wt. % (solids basis)	Tex-533-C	3.0	–	–	–	–	–	–	–	3.0	–
Penetration, 77°F, 100 g, 5 sec.	T 49	90	140	150	300	300	–	300	–	100	140
Solubility in trichloroethylene, %	T 44	97.0	–	97.0	–	97.0	–	97.0	–	97.0	–
Viscosity, 140°F, poise	T 202	1,500	–	–	–	–	–	–	–	1,300	–
Float test, 140°F, sec	T 50	1,200	–	1,200	–	1,200	–	1,200	–	–	–
Ductility,[2] 39.2°F, 5 cm/min., cm	T 51	50	–	–	–	–	–	–	–	50	–
Elastic recovery,2 50°F, %	Tex-539-C	55	–	–	–	–	–	–	–	–	–
Tests on RTFO curing of distillation residue	T 240										
Elastic recovery, 50°F, %	Tex-536-C	–	–	50	–	50	–	30	–	–	–

1. Exception to T 59: Bring the temperature on the lower thermometer slowly to 350°F ±10°F. Maintain at this temperature for 20 min. Complete total distillation in 60 min. (±5 min.) from the first application of heat.
2. HFRS-2P must meet one of either the ductility or elastic recovery requirements.

Table 10
Polymer-Modified Cationic Emulsified Asphalt

Property	Test Procedure	Type–Grade											
		Rapid-Setting						Medium-Setting				Slow-Setting	
		CRS-2P		CHFRS-2P		CRS-2TR		CMS-1P[3]		CMS-2P[3]		CSS 1P	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Viscosity, Saybolt Furol	T 72												
77°F, sec.		–	–	–	–	–	–	10	100	–	–	20	100
122°F, sec.		150	400	100	400	150	500	–	–	50	400	–	–
Sieve test, %	T 59	–	0.1	–	0.1	–	0.1	–	0.1	–	0.1	–	0.1
Demulsibility, 35 ml of 0.8% sodium dioctyl sulfosuccinate, %	T 59	70	–	60	–	40	–	–	–	–	–	–	–
Storage stability, 1 day, %	T 59	–	1	–	1	–	1	–	1	–	1	–	1
Breaking index, g	Tex-542-C	–	–	–	–	–	–	–	–	–	–	–	–
Particle charge	T 59	Positive		Positive		Positive		Positive		Positive		Positive	
Distillation test[1]:	T 59												
Residue by distillation, % by weight		65	–	65	–	65	–	30	–	60	–	62	–
Oil distillate, % by volume of emulsion		–	0.5	–	0.5	–	3	–	0.5	–	0.5	–	0.5
Tests on residue from distillation:													
Polymer content, wt. % (solids basis)	Tex-533-C	3.0	–	3.0	–	5.0[7]	–	–	–	–	–	3.0	–
Penetration, 77°F, 100 g, 5 sec.	T 49	90	150	80	130	90	150	30	–	30	–	55	90
Viscosity, 140°F, poise	T 202	1,300	–	1,300	–	1,000	–	–	–	–	–	–	–
Solubility in trichloroethylene, %	T44	97.0	–	95.0	–	98	–	–	–	–	–	97.0	–
Softening point, °F	T 53	–	–	–	–	–	–	–	–	–	–	135	–
Ductility, 77°F, 5 cm/min., cm	T 51	–	–	–	–	40	–	–	–	–	–	70	–
Float test, 140°F, sec.	T 50	–	–	1,800	–	–	–	–	–	–	–	–	–
Ductility,[2] 39.2°F, 5 cm/min., cm	T 51	50	–	–	–	–	–	–	–	–	–	–	–
Elastic recovery,[2] 50°F, %	Tex-539-C	55	–	55	–	–	–	–	–	–	–	–	–
Tests on residue from evaporative recovery:	R 78, Procedure B												
Nonrecoverable creep compliance of residue, 3.2 kPa, 52°C, kPa-[1]	T 350	–	–	–	–	–	–	–	2.0	–	4.0	–	–
Tests on rejuvenating agent:													
Viscosity, 140°F, cSt	T 201	–	–	–	–	–	–	50	175	50	175	–	–
Flash point, C.O.C., °F	T 48	–	–	–	–	–	–	380	–	380	–	–	–
Saturates, % by weight	D 2007	–	–	–	–	–	–	–	30	–	30	–	–
Solubility in n-pentane, % by weight	D 2007	–	–	–	–	–	–	99	–	99	–	–	–
Tests on rejuvenating agent after RTFO	T 240												
Weight Change, %		–	–	–	–	–	–	–	6.5	–	6.5	–	–
Viscosity Ratio		–	–	–	–	–	–	–	3.0	–	3.0	–	–
Tests on latex[4]:													
Tensile strength, die C dumbbell, psi	D 412[5]	–	–	–	–	–	–	800	–	800	–	–	–
Change in mass after immersion in rejuvenating agent, %	D 471	–	–	–	–	–	–	–	40[6]	–	40[6]	–	–

1. Exception to T 59: Bring the temperature on the lower thermometer slowly to 350°F (±0°F). Maintain at this temperature for 20 min. Complete total distillation in 60 min. (±5 min.) from the first application of heat.
2. CRS-2P must meet one of either the ductility or elastic recovery requirements.
3. With all precertification samples of CMS-1P or CMS-2P, submit certified test reports showing that the rejuvenating agent and latex meet the stated requirements. Submit samples of these raw materials if requested by the Engineer.
4. Preparation of latex specimens: use any substrate and recovery method which produces specimens of uniform dimensions and which delivers enough material to achieve desired residual thickness.
5. Cut samples for tensile strength determination using a crosshead speed of 20 in. per minute.
6. Specimen must remain intact after exposure and removal of excess rejuvenating agent.
7. Modifier type is tire rubber.

Table 10A
Non-Tracking Tack Coat Emulsion[1]

Property	Test Procedure	NT-HRE		NT-RRE		NT-SRE	
		Min	Max	Min	Max	Min	Max
Viscosity, Saybolt Furol 77º F, sec.	T 72	15	–	15	–	10	100
Storage stability, 1 Day, %	T 59	–	1	–	1	–	1
Settlement, 5-day, %	T 59	–	5	–	5	–	5
Sieve test, %	T 59	–	0.30	–	0.30	–	0.1
Distillation test:[2]	T 59						
Residue by distillation, % by wt.		50	–	58	–	50	–
Oil distillate, by volume of emulsion		–	1.0	–	1.0	–	1.0
Test on residue from distillation:							
Penetration, 77ºF, 100 g, 5 sec.	T 49	–	20	15	45	40	90
Solubility in trichloroethylene, %	T 44	97.5	–	97.5	–	97.5	–
Softening point, ºF	T 53	150	–	–	–	–	–
Dynamic shear, G*/sin(δ), 82°C, 10 rad/s, kPa	T 315	1.0	–	–	–	–	–

1. Due to the hardness of the residue, these emulsions should be heated to 120-140°F before thoroughly mixing as the emulsion is being prepared for testing.
2. Exception to T 59: Bring the temperature on the lower thermometer slowly to 350ºF ± 10ºF. Maintain at this temperature for 20 min. Complete total distillation in 60 ± 5 min. from first application of heat.

Table10B
Spray Applied Underseal Membrane Polymer-Modified Emulsions (EBL)

Property	Test Procedure	Min	Max
Viscosity @ 77°F, SSF	T 72	20	100
Storage Stability[1], %	T 59	–	1
Demulsibility[2] Anionic emulsions – 35 mL of 0.02 N CaCl2, % Cationic emulsions – 35 mL of 0.8% sodium dioctyl sulfosuccinate, %	T 59	55	–
Sieve Test[3], %	T 59	–	0.05
Distillation Test[4]	T 59		
Residue by distillation, % by wt.		63	
Oil portion of distillate, % by vol.			0.5
Test on Residue from Distillation			
Elastic Recovery @ 50°F, 50 mm/min., %	Tex-539-C	60	–
Penetration @ 77°F, 100 g, 5 sec., 0.1 mm	T 49	80	130

1. After standing undisturbed for 24 hr., the surface must be smooth, must not exhibit a white or milky colored substance, and must be a homogeneous color throughout.
2. Material must meet demulsibility test for emulsions.
3. May be required by the Engineer only when the emulsion cannot be easily applied in the field.
4. The temperature on the lower thermometer should be brought slowly to 350°F ± 10°F and maintained at this temperature for 20 min. The total distillation should be completed in 60 ± 5 min. from the first application of heat.

Table 10C
Full-Depth Reclamation Emulsion (FDR EM)

Property	Test Procedure	Standard Yield (SY)		High Yield (HY)	
		Min	Max	Min	Max
Sieve test, %	T 59	–	0.1	–	0.1
Viscosity Saybolt Furol @ 77°F, sec.	T 59	20	100	20	100
Distillation test[1]:	T 59				
Residue by distillation, % by wt.		60	–	63	–
Oil portion of distillate, % by vol.		–	0.5	–	0.5
Test on residue from distillation:	T 49				
Penetration @ 77°F, dmm		55	95	120	–
Test on rejuvenating agent:					
BWOA, %[2]	***	–	–	2	–
Viscosity @ 140°F, cSt	T 201	–	–	50	175
Flash Point, COC, °F	T 48	–	–	380	–
Solubility in n-pentane, % by wt.	D2007	–	–	99	–

1. The temperature on the lower thermometer should be brought slowly to 350°F ±10°F and maintained at this temperature for 20 min. The total distillation should be completed in 60 ± 5 min. from the first application of heat.
2. BWOA = By weight of asphalt. Provide a manufacturer's certificate of analysis (COA) with the percent of rejuvenator added.

2.5. **Specialty Emulsions.** Provide specialty emulsion that is either asphalt-based or resin-based and meets the requirements of Table 11 or Table 11A.

Table 11
Specialty Emulsions

Property	Test Procedure	Type–Grade					
		Medium-Setting				Slow-Setting	
		AE-P		EAP&T		PCE[1]	
		Min	Max	Min	Max	Min	Max
Viscosity, Saybolt Furol	T 72						
77°F, sec.		–	–	–	–	10	100
122°F, sec.		15	150	–	–	–	–
Sieve test, %	T 59	–	0.1	–	0.1	–	0.1
Miscibility[2]	T 59	–		Pass		Pass	
Demulsibility, 35 mL of 0.10 N $CaCl^2$, %	T 59	–	70	–	–	–	–
Storage stability, 1 day, %	T 59	–	1	–	1	–	–
Particle size,[5] % by volume < 2.5 μm	Tex-238-F[3]	–	–	90	–	90	–
Asphalt emulsion distillation to 500°F followed by Cutback asphalt distillation of residue to 680°F:	T 59 & T 78						
Residue after both distillations, % by wt.		40	–	–	–	–	–
Total oil distillate from both distillations, % by volume of emulsion		25	40	–	–	–	–
Residue by distillation, % by wt.	T 59	–	–	60	–	–	–
Residue by evaporation,[4] % by wt.	T 59	–	–	–	–	60	–
Tests on residue after all distillations:							
Viscosity, 140°F, poise	T 202	–	–	800	–	–	–
Kinematic viscosity,[5] 140°F, cSt	T 201	–	–	–	–	100	350
Flash point C.O.C., °F	T 48	–	–	–	–	400	–
Solubility in trichloroethylene, %	T 44	97.5	–	–	–	–	–
Float test, 122°F, sec.	T 50	50	200	–	–	–	–

1. Supply with each shipment of PCE:
   - a copy of a lab report from an approved analytical lab, signed by a lab official, indicating the PCE formulation does not meet any characteristics of a Resource Conservation Recovery Act (RCRA) hazardous waste;
   - a certification from the producer that the formulation supplied does not differ from the one tested and that no listed RCRA hazardous wastes or Polychlorinated Biphenyls (PCBs) have been mixed with the product; and
   - a Safety Data Sheet.
2. Exception to T 59: In dilution, use 350 mL of distilled or deionized water and a 1,000-mL beaker.
3. Use Tex-238-F, beginning at "Particle Size Analysis by Laser Diffraction," with distilled or deionized water as a medium and no dispersant, or use another approved method.
4. Exception to T 59: Leave sample in the oven until foaming ceases, then cool and weigh.
5. PCE must meet either the kinematic viscosity requirement or the particle size requirement.

Table 11A
Hard Residue Surface Sealant

Property	Test Procedure	Min	Max
Viscosity, Krebs unit, 77ºF, Krebs units	D 562	45	75
Softening point, ºF	Tex-505-C[1]	250	–
Uniformity	D 2939	Pass[2]	
Resistance to heat	D 2939	Pass[3]	
Resistance to water	D 2939	Pass[4]	
Wet flow, mm	D 2939	–	0
Resistance to Kerosene (optional)[5]	D 2939	Pass[6]	
Ultraviolet exposure, UVA-340, 0.77 W/m^2, 50°C chamber, 8 hr. UV lamp, 5 min. spray, 3 hr. 55 min. condensation, 1,000 hr. total exposure[7]	G 154	Pass[8]	
Abrasion loss, 1.6 mm thickness, liquid only, %	ISSA TB-100	–	1.0
Residue by evaporation, % by weight	D 2939	33	–
Tests on residue from evaporation: Penetration, 77ºF, 100 g, 5 sec. Flash point, Cleveland open cup, °F	 T 49 T 48	 15 500	 30
Tests on base asphalt before emulsification Solubility in trichloroethylene, %	 T 44	 98	 –

1. Cure the emulsion in the softening point ring in a 200°F ± 5°F oven for 2 hr.
2. Product must be homogenous and show no separation or coagulation that cannot be overcome by moderate stirring.
3. No sagging or slippage of film beyond the initial reference line.
4. No blistering or re-emulsification.
5. Recommended for airport applications or where fuel resistance is desired.
6. No absorption of Kerosene into the clay tile past the sealer film. Note sealer surface condition and loss of adhesion.
7. Other exposure cycles with similar levels of irradiation and conditions may be used with Department approval.
8. No cracking, chipping, surface distortion, or loss of adhesion. No color fading or lightening.

2.6. **Recycling Agent**. Recycling agent and emulsified recycling agent must meet the requirements in Table 12. Additionally, recycling agent and residue from emulsified recycling agent, when added in the specified proportions to the recycled asphalt, must meet the properties specified on the plans.

Table 12
Recycling Agent and Emulsified Recycling Agent

Property	Test Procedure	Recycling Agent		Emulsified Recycling Agent (ARA-1)		Polymer Modified Emulsified Recycling Agent (ARA-1P)	
		Min	Max	Min	Max	Min	Max
Viscosity, Saybolt Furol, 77°F, sec.	T 72	–	–	15	100	15	110
Sieve test, %	T 59	–	–	–	0.1	–	0.1
Miscibility[1]	T 59	–		No coagulation			
Residue by evaporation,[2] % by wt.	T 59	–	–	60	–	–	–
Distillation test: Residue by distillation, % by wt. Oil distillate, % by volume of emulsion	T 59					 60 –	 65 2
Penetration of Distillation Residue at 39.2°F, 100 g, 5 sec.	T 49					110	190
Tests on recycling agent or residue from evaporation: Flash point, C.O.C., °F Kinematic viscosity, 140°F, cSt 275°F, cSt	 T 48 T 201	 400 75 –	 – 200 10.0	 400 75 –	 – 200 10.0	 400	 –

1. Exception to T 59: Use 0.02 N CaCl2 solution in place of water.
2. Exception to T 59: Maintain sample at 300°F until foaming ceases, then cool and weigh.

2.7. **Crumb Rubber Modifier**. Crumb rubber modifier (CRM) consists of automobile and truck tires processed by ambient temperature grinding.

CRM must be:

- free from contaminants including fabric, metal, and mineral and other nonrubber substances;
- free-flowing; and
- nonfoaming when added to hot asphalt binder.

Ensure rubber gradation meets the requirements of the grades in Table 13 when tested in accordance with Tex-200-F, Part I, using a 50-g sample.

Table 13
CRM Gradations

Sieve Size (% Passing)	Grade A		Grade B		Grade C		Grade D	Grade E
	Min	Max	Min	Max	Min	Max		
#8	100	–	–	–	–	–	As shown on the plans	As approved
#10	95	100	100	–	–	–		
#16	–	–	70	100	100	–		
#30	–	–	25	60	90	100		
#40	–	–	–	–	45	100		
#50	0	10	–	–	–	–		
#200	–	–	0	5	–	–		

2.8. **Crack Sealer**. Provide polymer-modified asphalt-emulsion crack sealer meeting the requirements of Table 14. Provide rubber-asphalt crack sealer meeting the requirements of Table 15.

Table 14
Polymer-Modified Asphalt-Emulsion Crack Sealer

Property	Test Procedure	Min	Max
Rotational viscosity, 77°F, cP	D 2196, Method A	10,000	25,000
Sieve test, %	T 59	–	0.1
Storage stability, 1 day, %	T 59	–	1
Evaporation Residue by evaporation, % by wt.	Tex-543-C	65	–
Tests on residue from evaporation: Penetration, 77°F, 100 g, 5 sec. Softening point, °F Ductility, 39.2°F, 5 cm/min., cm	 T 49 T 53 T 51	 35 140 100	 75 – –

Table 15
Rubber-Asphalt Crack Sealer

Property	Test Procedure	Class A		Class B	
		Min	Max	Min	Max
CRM content, Grade A or B, % by wt.	Tex-544-C	22	26	–	–
CRM content, Grade B, % by wt.	Tex-544-C	–	–	13	17
Virgin rubber content,[1] % by wt.		–	–	2	–
Flash point,[2] C.O.C., °F	T 48	400	–	400	–
Penetration,[3] 77°F, 150 g, 5 sec.	T 49	30	50	30	50
Penetration,[3] 32°F, 200 g, 60 sec.	T 49	12	–	12	–
Softening point, °F	T 53	–	–	170	–
Bond Test, non-immersed, 0.5 in specimen, 50% extension, 20°F[4]	D5329	–		Pass	

1. Provide certification that the Min % virgin rubber was added.
2. Agitate the sealing compound with a 3/8- to 1/2 in. (9.5- to 12.7 mm) wide, square-end metal spatula to bring the material on the bottom of the cup to the surface (i.e., turn the material over) before passing the test flame over the cup. Start at one side of the thermometer, move around to the other, and then return to the starting point using 8 to 10 rapid circular strokes. Accomplish agitation in 3 to 4 sec. Pass the test flame over the cup immediately after stirring is completed.
3. Exception to T 49: Substitute the cone specified in D 217 for the penetration needle.
4. Allow no crack in the crack sealing materials or break in the bond between the sealer and the mortar blocks over 1/4 in. deep for any specimen after completion of the test.

2.9. **Asphalt-Rubber Binders**. Provide asphalt-rubber (A-R) binders that are mixtures of asphalt binder and CRM, which have been reacted at elevated temperatures. Provide A-R binders meeting D6114 and containing a minimum of 15% CRM by weight. Provide Types I or II, containing CRM Grade C, for use in hot-mixed aggregate mixtures. Provide Types II or III, containing CRM Grade B, for use in surface treatment binder. Ensure binder properties meet the requirements of Table 16.

Table 16
A-R Binders

Property	Test Procedure	Binder Type					
		Type I		Type II		Type III	
		Min	Max	Min	Max	Min	Max
Apparent viscosity, 347°F, cP	D2196, Method A	1,500	5,000	1,500	5,000	1,500	5,000
Penetration, 77°F, 100 g, 5 sec.	T 49	25	75	25	75	50	100
Penetration, 39.2°F, 200 g, 60 sec.	T 49	10	–	15	–	25	–
Softening point, °F	T 53	135	–	130	–	125	–
Resilience, 77°F, %	D5329	25	–	20	–	10	–
Flash point, C.O.C., °F	T 48	450	–	450	–	450	–
Tests on residue from Thin-Film Oven Test: Retained penetration ratio, 39.2°F, 200 g, 60 sec., % of original	T 179 T 49	75	–	75	–	75	–

2.10. **Performance-Graded Binders**. Provide PG binders that are smooth and homogeneous, show no separation when tested in accordance with Tex-540-C, and meet the requirements of Table 17.

Separation testing is not required if:

- a modifier is introduced separately at the mix plant either by injection in the asphalt line or mixer,
- the binder is blended on site in continuously agitated tanks, or
- binder acceptance is based on field samples taken from an in-line sampling port at the hot-mix plant after the addition of modifiers.

Table 17
Performance-Graded Binders

Property and Test Method	Performance Grade																		
	PG 58			PG 64				PG 70				PG 76				PG 82			
	-22	-28	-34	-16	-22	-28	-34	-16	-22	-28	-34	-16	-22	-28	-34	-16	-22	-28	
Average 7-day max pavement design temperature, °C[1]	58			64				70				76				82			
Min pavement design temperature, °C[1]	-22	-28	-34	-16	-22	-28	-34	-16	-22	-28	-34	-16	-22	-28	-34	-16	-22	-28	
Original Binder																			
Flash point, T 48, Min, °C	230																		
Viscosity, T 316[2, 3]: Max, 3.0 Pa·s, test temperature, °C	135																		
Dynamic shear, T 315[4]: G*/sin(δ), Min, 1.00 kPa, Max, 2.00 kPa[7], Test temperature @ 10 rad/sec., °C	58			64				70				76				82			
Elastic recovery, D6084, 50°F, % Min[8]	–	–	30	–	–	30	50	–	30	50	60	30	50	60	70	50	60	70	
Rolling Thin-Film Oven (Tex-506-C)																			
Mass change, T 240, Max, %	1.0																		
Dynamic shear, T 315: G*/sin(δ), Min, 2.20 kPa, Max, 5.00 kPa[7], Test temperature @ 10 rad/sec., °C	58			64				70				76				82			
MSCR, T350, Recovery, 0.1 kPa, High Temperature, % Min[8]	–	–	20	–	–	20	30	–	20	30	40	20	30	40	50	30	40	50	
Pressure Aging Vessel (PAV) Residue (R 28)																			
PAV aging temperature, °C	100																		
Dynamic shear, T 315: G*sin(δ), Max, 5,000 kPa Test temperature @ 10 rad/sec., °C	25	22	19	28	25	22	19	28	25	22	19	28	25	22	19	28	25	22	
Creep stiffness, T 313[5, 6]: *S*, max, 300 MPa, *m*-value, Min, 0.300 Test temperature @ 60 sec., °C	-12	-18	-24	-6	-12	-18	-24	-6	-12	-18	-24	-6	-12	-18	-24	-6	-12	-18	
Direct tension, T 314[6]: Failure strain, min, 1.0% Test temperature @ 1.0 mm/min., °C	-12	-18	-24	-6	-12	-18	-24	-6	-12	-18	-24	-6	-12	-18	-24	-6	-12	-18	

1. Pavement temperatures are estimated from air temperatures and using an algorithm contained in a Department-supplied computer program, may be provided by the Department, or by following the procedures outlined in AASHTO MP 2 and PP 28.
2. This requirement may be waived at the Department's discretion if the supplier warrants that the asphalt binder can be adequately pumped, mixed, and compacted at temperatures that meet all applicable safety, environmental, and constructability requirements. At test temperatures where the binder is a Newtonian fluid, any suitable standard means of viscosity measurement may be used, including capillary (T 201 or T 202) or rotational viscometry (T 316).
3. Viscosity at 135°C is an indicator of mixing and compaction temperatures that can be expected in the lab and field. High values may indicate high mixing and compaction temperatures. Additionally, significant variation can occur from batch to batch. Contractors should be aware that variation could significantly impact their mixing and compaction operations. Contractors are therefore responsible for addressing any constructability issues that may arise.
4. For quality control of unmodified asphalt binder production, measurement of the viscosity of the original asphalt binder may be substituted for dynamic shear measurements of G*/sin(δ) at test temperatures where the asphalt is a Newtonian fluid. Any suitable standard means of viscosity measurement may be used, including capillary (T 201 or T 202) or rotational viscometry (T 316).
5. Silicone beam molds, as described in AASHTO TP 1-93, are acceptable for use.
6. If creep stiffness is below 300 MPa, direct tension test is not required. If creep stiffness is between 300 and 600 MPa, the direct tension failure strain requirement can be used instead of the creep stiffness requirement. The m value requirement must be satisfied in both cases.
7. Maximum values for unaged and RTFO aged dynamic shear apply only to materials used as substitute binders, as described in Item 340, "Dense-Graded Hot-Mix Asphalt (Small Quantity)", Item 341, "Dense-Graded Hot-Mix Asphalt, and Item 344, "Superpave Mixtures."
8. Elastic Recovery (ASTM D6084) is not required unless MSCR (AASHTO T 350) is less than the minimum % recovery. Elastic Recovery must be used for the acceptance criteria in this instance.

3. EQUIPMENT

Provide all equipment necessary to transport, store, sample, heat, apply, and incorporate asphalts, oils, and emulsions.

4. CONSTRUCTION

Typical Material Use. Use materials shown in Table 18, unless otherwise determined by the Engineer.

Table18
Typical Material Use

Material Application	Typically Used Materials
Hot-mixed, hot-laid asphalt mixtures	PG binders, A-R binders Types I and II
Surface treatment	AC-5, AC-10, AC-15P, AC-20XP, AC-10-2TR, AC-20-5TR, HFRS-2, MS-2, CRS-2, CRS-2H, CRS-2TR, CMS-2P HFRS-2P, CRS-2P, CHFRS-2P, A-R binders Types II and III
Surface treatment (cool weather)	AC12-5TR, RC-250, RC-800, RC-3000, MC-250, MC-800, MC-3000, MC-2400L, CMS-2P
Precoating	AC-5, AC-10, PG 64-22, SS-1, SS-1H, CSS-1, CSS-1H
Tack coat	PG Binders, SS-1H, CSS-1H, EAP&T, TRAIL, EBL
Fog seal	SS-1, SS-1H, CSS-1, CSS-1H, CMS-1P
Hot-mixed, cold-laid asphalt mixtures	AC-0.6, AC-1.5, AC-3, AES-300, AES-300P, CMS-2, CMS-2S
Patching mix	MC-800, SCM I, SCM II, AES-300S
Recycling	AC-0.6, AC-1.5, AC-3, AES-150P, AES-300P, recycling agent, emulsified recycling agent
Crack sealing	SS-1P, polymer mod AE crack sealant, rubber asphalt crack sealers (Class A, Class B)
Microsurfacing	CSS-1P
Prime	MC-30, AE-P, EAP&T, PCE
Curing membrane	SS-1, SS-1H, CSS-1, CSS-1H, PCE
Erosion control	SS-1, SS-1H, CSS-1, CSS-1H, PCE
FDR -Foaming	PG 64-22, FDR EM-SY, FDR EM-HY

4.1. **Storage and Application Temperatures**. Use storage and application temperatures in accordance with Table 19. Store and apply materials at the lowest temperature yielding satisfactory results. Follow the manufacturer's instructions for any agitation requirements in storage. Manufacturer's instructions regarding recommended application and storage temperatures supersede those of Table 19.

Table19
Storage and Application Temperatures

Type-Grade	Application		Storage Max (°F)
	Recommended Range (°F)	Max Allowable (°F)	
AC-0.6, AC-1.5, AC-3	200–300	350	350
AC-5, AC-10	275–350	350	350
AC-15P, AC-20-5TR, AC12-5TR and AC10-2TR	300–375	375	360
RC-250	125–180	200	200
RC-800	170–230	260	260
RC-3000	215–275	285	285
MC-30, AE-P	70–150	175	175
MC-250	125–210	240	240
MC-800, SCM I, SCM II	175–260	275	275
MC-3000, MC-2400L	225–275	290	290
HFRS-2, MS-2, CRS-2, CRS-2H, HFRS-2P, CRS-2P, CMS-2, CMS-2S, AES-300, AES-300S, AES-150P, AES-300P, CRS-2TR	120–160	180	180
SS-1, SS-1H, CSS-1, CSS-1H, PCE, EAP&T, SS-1P, RS-1P, CRS-1P, CSS-1P, recycling agent, emulsified recycling agent, polymer mod AE crack sealant	50–130	140	140
PG binders	275–350	350	350
Rubber asphalt crack sealers (Class A, Class B)	350–375	400	–
A-R binders Types I, II, and III	325–425	425	425

5. MEASUREMENT AND PAYMENT

The work performed, materials furnished, equipment, labor, tools, and incidentals will not be measured or paid for directly but is subsidiary or is included in payment for other pertinent Items.

Special Specification 6000
Illumination Maintenance

1. DESCRIPTION

Maintain, install, repair, or replace the various appurtenances related to existing illumination systems.

2. LICENSES AND CERTIFICATION

Provide personnel with electrical licensing and electrical certification in accordance with Item 7, "Legal Relations and Responsibilities," and all applicable Special Provisions to Item 7, "Legal Relations and Responsibilities."

3. MATERIALS

Unless otherwise noted on the plans, the Department will furnish luminaires, luminaire poles, mast arms, anchor bolts, and transformer bases. Assume responsibility for all materials furnished by the Department. Use material furnished by the Department for this contract only.

Furnish all materials required to repair breaks or shorts in electrical conductors and cables, including, but not be limited to, all concrete, ground boxes, wire mesh, conduit, conductors, and pipe casing. Ensure materials furnished by the Contractor meet all Department standards and specification requirements.

Return unused or removed salvageable material to the Department upon completion of work and before final payment, at the location shown on the plans or as directed. Dispose of any unsalvageable material in accordance with federal, state, and local regulations.

When performing maintenance on luminaires, verify if fixtures are covered under the manufacturer's warranty. If warranty applies, coordinate with the Department and follow any necessary procedures to have the manufacturer replace or repair fixtures.

4. EQUIPMENT

Furnish all equipment, tools and machinery necessary for the proper prosecution of the work. This will include, but is not limited to, an aerial device capable of reaching, installing and erecting all overhead lights and poles, trenching machine, boring machine, underground conductor detectors, underground fault detectors and splicing tools.

Ensure equipment, tools, and machinery is at the worksite and is in good repair and operating condition before beginning work. Immediately repair or replace any equipment that may affect the quality of the work, as directed.

5. WORK METHODS

Conform to the latest edition of the National Electric Code (NEC) as adopted by the Texas Department of Licensing and Regulations, local utility requirements, the requirements of this Item, and the pertinent requirements of the following Items:

- Item 104, "Removing Concrete"
- Item 400, "Excavation and Backfill for Structures"
- Item 416, "Drilled Shaft Foundations"

- Item 421, “Hydraulic Cement Concrete”
- Item 431, “Pneumatically Placed Concrete”
- Item 432, “Riprap”
- Item 440, “Reinforcing Steel”
- Item 476, “Jacking, Boring or Tunneling Pipe or Box”
- Item 610, “Roadway Illumination Assemblies”
- Item 613, “High Mast Illumination Poles”
- Item 614, “High Mast Illumination Assemblies”
- Item 616, “Performance Testing of Lighting Systems”
- Item 618, “Conduit”
- Item 620, “Conductors”
- Item 621, “Tray Cable”
- Item 622, “Duct Cable”
- Item 624, “Ground Boxes”
- Item 627, “Treated Timber Poles”
- Item 628, “Electrical Services”
- Item 652, “Highway Sign Lighting Fixtures”

Perform work on this contract as directed. Maintain existing roadway illumination systems as directed. Perform a monthly inspection to determine if any maintenance of the illumination system are needed and provide a detailed report to the Engineer. Provide proper maintenance or repairs within 48 hr. of notification. Submit completed maintenance log as directed. Coordinate electric power issues with local utility company.

The term “duct cable” as used herein consists of a complete assembly of conductors enclosed in a high density polyethylene duct.

Perform maintenance, installation, removal, or replacement activities located near any overhead or underground utilities using established industry and utility safety practices. Consult with the appropriate utility company before beginning such work.

Maintain, install, repair or replace the following items in accordance with the details as shown on the plans, the NEC and as directed:

5.1. **Conduit**. Install, remove, or replace conduits in accordance with Item 618, “Conduit.” Use 90° “sweep” type elbows on conduits entering a ground box or foundation.

5.2. **Electrical Conductors**. Install, remove, or replace electrical conductors in accordance with Item 620, “Electrical Conductors.”

Strap cable as required when installing or replacing conductors in aerial runs. This work is subsidiary to this Item.

5.3. **Tray Cable**. Install, remove, or replace tray cable in accordance with Item 621, “Tray Cable.”

5.4. **Duct Cable**. Install, remove, or replace duct cable in accordance with Item 622, “Duct Cable.”

5.5. **Conduit or Duct Cable Repair and Conductor Splices**. Notify the Engineer when an underground break in duct cable or conduit must be located or if a short in a conductor must be located.

Expose the break or short, install the ground box, repair the conduit or duct cable, perform the electrical splices, and backfill. Backfill in accordance with the construction methods of Item 400, “Excavation and Backfill for Structures.” New ground boxes will be paid for under, “Install Ground Box.”

When a ground box is not needed, expose the break or short, repair conduit or duct cable, remove damaged conductors, and install new conductors. Replace up to 3 ft. of conduit when repairing duct cable, regardless of the number of conduits in trench. Only one repair will be considered for payment per trench. If more than 3 ft. of conduit or duct cable needs to be replaced the additional will be paid for under "Replace Underground Conduit" or "Replace Duct Cable." Replacement of conductors will be paid for under "Install or Replace Conductor." Backfill in accordance with the construction methods of Item 400, "Excavation and Backfill for Structures."

An electrical splice will include the replacement of up to 3 ft. of conductor, regardless of the number of conductors in the conduit. Only one splice will be considered for payment per conduit. If more than 3 ft. of conductor needs to be replaced the additional will be paid for under "Install or Replace Conductor."

Above-ground conduit repairs performed in conjunction with a bid item will be considered subsidiary to the pertinent bid item. Above-ground conduit repairs not performed in conjunction with a bid item will include the replacement of up to 3 ft. of conduit per repair. If more than 3 ft. of conduit must be replaced, the additional will be paid for under "Replace Above-Ground Conduit."

5.6. **Bore Operations**. Place underground wiring under roadways by boring in accordance with the construction methods for boring as outlined in Item 476, "Jacking, Boring or Tunneling Pipe or Box." Bore a minimum of 60 in. below the roadway surface (and a minimum of 36 in. below the ditch flow-line) and extend 10 ft. outside the edge of the roadway or as directed. Placement of conduit for the length of the bore will be considered subsidiary to this bid item. Electrical conductors will be paid for under the bid item "Install or Replace Conductor."

5.7. **Install, Remove, or Replace Roadway Illumination Assembly**. Install, remove, or replace roadway illumination assemblies. This will include the base, pole, luminaire arms, luminaire, and required wiring.

5.8. **Install, Remove, or Replace Underpass Luminaire**. Install, remove, or replace underpass luminaires. This will include the luminaire, junction box, mounting hardware, and required wiring.

5.9. **Install, Remove, or Replace Induction Fluorescent Fixture**. Install, remove, or replace induction fluorescent fixture.

5.10. **Install, Remove, or Replace Luminaire**. Install, remove, or replace luminaire.

5.11. **Replace High Mast Luminaires**. Replace high mast luminaires.

5.12. **Replace Luminaire Pole**. Replace luminaire pole. Removing and reinstalling existing luminaires and arms is subsidiary to this item.

5.13. **Replace Luminaire Arms**. Replace luminaire arms.

5.14. **Maintenance of Roadway Illumination**. Maintain roadway illumination assemblies including replacement of lamps, fuses, fuse holder, starting aid, photocells, ballasts, and other work required to keep lights operational. Relevel the fixture. Clean the reflector and inside and outside of lens with an approved cleaning solution.

5.15. **Maintenance of High Mast Illumination**. Maintain high mast illumination assemblies including lowering the ring assembly and the replacement of lamps, fuses, fuse holder, starting aid, photocells, ballasts, and other work required to keep lights operational. Re-aim the lights and clean the lenses and reflectors as directed. Clean the reflector and inside and outside of lens with an approved cleaning solution. Maintain mechanical and electrical equipment as directed.

5.16. **Maintenance of Overhead Sign Lighting**. Maintain overhead sign lighting for large signs mounted over the roadway including replacing the ballast, lamps, fuses and lamp sockets in order to properly restore the

lighting to satisfactory operation. Install in accordance with the details shown on the plans or as directed. Clean the reflector and inside and outside of lens with an approved cleaning solution.

5.17. **Maintenance of Underpass Fixtures**. Maintain HPS underpass fixtures including the replacement of lamps, fuses, fuse holder, starting aid, photocells, ballasts, and other work required to keep lights operational. Relevel the fixture. Clean the reflector and inside and outside of lens with an approved cleaning solution.

5.18. **Maintenance of Induction Fluorescent Fixtures**. Maintain induction fluorescent fixtures including the replacement of lamps, fuses, fuse holder, starting aid, photocells, ballasts, and other work required to keep lights operational. Relevel the fixture. Clean the reflector and inside and outside of lens with an approved cleaning solution.

5.19. **Scheduled Preventive Maintenance of Roadway Illumination Assembly**. Inspect and perform the following listed items according to the schedule provided by the Engineer:

- Inspect and maintain all foundation anchor bolts, nuts, and washers.
- Prep and touch up rust spots with cold galvanizing spray.
- Replace lamp and clean fixtures as directed.
- Replace ballast as directed.
- Level fixture.
- Inspect electrical system.
- Repair shorts or open circuits.

5.20. **Scheduled Preventive Maintenance of High Mast Assembly**. Complete and sign "Luminaire Preventive Maintenance for High Mast Lighting" reports. Fill out forms legibly and completely. List all materials used at each location.

Inspect and perform the following listed items according to the schedule provided by the Engineer:

- Inspect and fill gearbox lubrication reservoir.
- Lubricate grease fittings.
- Adjust brake mechanism to proper torque.
- Inspect cable drum.
- Inspect all wire rope and cables for deterioration or wear.
- Inspect safety lanyard.
- Lower ring and inspect mechanism.
- Inspect all foundation anchor bolts, nuts, and washers.
- Inspect welds around baseplate and ground sleeve for visible cracks.
- Prep and touch up rust spots with cold galvanizing spray.
- Replace lamps and clean fixtures as directed.
- Replace ballasts as directed.
- Replace aviation warning (obstruction) lamps as directed.
- Inspect electrical system.
- Repair short or open circuits as directed.
- Raise ring to proper position.

5.21. **Replace Electrical Services**. Replace electrical services in accordance with Item 628, "Electrical Services."

5.22. **Replace Service Pole**. Replace service poles by removing the existing service pole, installing the new pole and related electrical service equipment, installing conduit including the elbow below ground for underground service feed or the weatherhead for overhead service feed, and connecting and installing electrical service. Install in accordance with Item 628, "Electrical Services."

5.23. **Install Ground Box**. Install ground boxes in conformance with the details shown on the plans and Item 624, "Ground Boxes." When shown on the plans, provide a Class "A" concrete apron conforming to Item 421,

"Hydraulic Cement Concrete." Place ground box to line and grade as approved. All wiring connections required inside the ground box will be considered subsidiary to this bid item.

5.24. **Remove Ground Box**. Remove ground box and fill hole with approved fill to at least 6 in. below conduit level. Remove conductors from conduit back to the point of termination. Uncover enough conduit that 90° bends can be removed and conduit reconnected. Clean conduit as per Item 618, "Conduit," and pull and terminate new conductors. Conduit replaced within 5 ft. of the ground box will be subsidiary to this Item. Cleaning of conduit and pulling of conductors will be paid under "Install or Replace Conductor." Backfill in accordance with the construction methods of Item 400, "Excavation and Backfill for Structures." If more than 5 ft. of conduit or duct cable needs to be replaced the additional will be paid for under "Replace Underground Conduit" or "Replace Duct Cable."

If applicable, ground box removal includes removing the existing riprap apron.

5.25. **Install Foundation**. Install foundation for roadway illumination assemblies as shown on the plans and in accordance with the materials and construction methods outlined in Item 416, "Drilled Shaft Foundations."

5.26. **Remove Foundation**. Remove foundations in accordance with Item 610, "Roadway Illumination Assemblies," and Item 104, "Removing Concrete." Backfill in accordance with the construction methods of Item 400, "Excavation and Backfill for Structures."

5.27. **Replace Transformer Base**. Replace transformer base in accordance with the plans or as directed. The removal of the pole, mast arm, and luminaire for replacement of the transformer base only will be considered subsidiary to the pertinent bid items.

5.28. **Replace Transformer Base Cover**. Replace damaged or missing covers on existing transformer bases.

5.29. **Replace Hand Hole Cover**. Replace damaged or missing covers on existing illumination poles.

5.30. **Install Ground Rod**. The installation of ground rods will include running a properly sized copper grounding conductor to the ground connection.

5.31. **Replace Ballast**. Replace ballast for pole mounted, underpass, sign and wall pack fixtures in accordance with the details shown on the plans or as directed.

5.32. **Replace Ballast (High Mast Lighting)**. Replace ballast for high mast fixtures.

5.33. **Install or Replace Fused Disconnect**. Install or replace fused disconnect.

5.34. **Replace Lamp Socket**. Replace lamp socket for pole mounted, underpass, high mast and wall pack fixtures.

5.35. **Replace Lamp**. Replace lamps for pole mounted, underpass, sign and wall pack fixtures. Clean the reflector and inside and outside of lens with an approved cleaning solution.

5.36. **Replace Lamp (High Mast Lighting)**. Replace lamp for individual high mast fixtures. Clean the reflector and inside and outside of lens with an approved cleaning solution.

5.37. **Replace Wall Pack Luminaires**. Replace wall pack luminaires on structures, rest areas, maintenance warehouses, and other facilities.

5.38. **Replace Lens**. Replace pole mounted, underpass, sign, wall pack or high mast luminaire lenses.

5.39. **Replace Wall Pack Guard**. Replace wall pack guard.

5.40. **Replace Fuses**. Replace fuses for pole mounted, underpass, sign and wall pack fixtures, and fused disconnects.

5.41. **Replace Fuse Holders**. Replace fuse holder for pole mounted, underpass, sign and wall pack fixtures.

5.42. **Replace Breakaway Fuse Holders**. Replace breakaway fuse.

5.43. **Replace Starting Aid**. Replace starting aid for pole mounted, underpass, sign and wall pack fixtures.

5.44. **Replace Photocells and Brackets**. Replace photocells and brackets.

5.45. **Replace Control Transformer**. Replace the control transformer.

5.46. **Replace Control Circuit**. Replace the control circuit.

5.47. **Replace Aviation Warning Fixtures**. Replace the aviation warning (obstruction) fixtures.

5.48. **Replace Aviation Warning Lamp**. Replace the aviation warning (obstruction) fixture lamp

5.49. **Replace Hand-Off-Auto Switch**. Replace three position Hand-Off-Automatic control switch.

5.50. **Replace Contactor**. Replace electromagnetic contactors.

5.51. **Replace Meter Bases**. Replace meter bases according to electrical service provider's requirements.

5.52. **Replace Time Clocks**. Replace time clocks.

5.53. **Replace Breaker Panel**. Replace breaker panel.

5.54. **Install or Replace Circuit Breaker**. Install or replace circuit breakers.

5.55. **Replace Flexible Power Cable or Cord**. Replace flexible power cable or cord.

5.56. **Replace Twist Lock Connectors**. Replace twist lock connectors.

5.57. **Replace Safety Lanyard**. Replace safety lanyard.

5.58. **Raise and Lower Ring (High Mast Lighting)**. Raise and lower ring in order to perform various maintenance and repair items.

5.59. **Restrap Existing Conduit**. Restrap existing conduit in accordance with the details shown on the plans or as directed.

5.60. **Replace Missing Nuts, Washers, and Other Hardware**. Replace missing nuts washers, and other miscellaneous hardware.

5.61. **Troubleshoot for Repairs**. Troubleshoot location as directed to identify work needed for repairs.

5.62. **Project Inspections**. Inspect and review the project to determine if any items are in need of repair and provide the Engineer with a list of these items. Make repairs to those items as approved. All repairs will be paid for by their respective pay items.

5.63. **Install or Replace Safety Switch.** Install or Replace Safety Switch.

5.64. **Replace 5/16 in. Wire Rope.** Replace 5/16 in. wire rope with swaged terminals.

5.65. **Replace 3/8 in. Wire Rope.** Replace 3/8 in. wire rope with swaged terminals.

5.66. **Replace High Mast Winch.** Replace high mast winch.

5.67. **Replace Wire Rope Pulley.** Replace wire rope pulley.

5.68. **Replace Electrical Cable Pulley.** Replace electrical cable pulley.

5.69. **Install or Replace Access Hole Cover**. Replace damaged or missing access covers on existing high mast poles.

5.70. **Replace High Mast Springs.** Replace high mast spring set.

5.71. **Remove and Reinstall High Mast Pole for Repairs.** Remove and reinstall high mast pole from the foundation to perform any repairs to internal components.

6. MEASUREMENT

This Item will be measured as follows.

6.1. **Conduit**. By the foot of conduit installed, removed, or replaced. This will include the installation of all hardware necessary to attach and connect the conduit, and any excavation, backfill and compaction.

- Install Above-Ground Conduit
- Remove Above-Ground Conduit
- Replace Above-Ground Conduit
- Install Underground Conduit
- Remove Underground Conduit
- Replace Underground Conduit

6.2. **Electrical Conductors**. By the foot of electrical conductor installed, removed, or replaced.

- Install Conductor
- Remove Conductor
- Replace Conductor

6.3. **Tray Cable**. By the foot of tray cable installed, removed, or replaced.

- Install Tray Cable
- Remove Tray Cable
- Replace Tray Cable

6.4. **Duct Cable**. By the foot of duct cable installed, removed, or replaced. This will include excavation, backfill, and compaction.

- Install Duct Cable
- Remove Duct Cable
- Replace Duct Cable

6.5. **Conduit or Duct Cable Repair and Conductor Splices**.

- Install Electrical Splice. By each electrical splice installed per conduit.
- Repair Above-Ground Conduit. By each conduit location repaired. This will include the installation of all hardware necessary to attach and connect the conduit
- Repair Underground Conduit. By each conduit location repaired. This will include excavation, placement of conduit, backfill and compaction.
- Repair Underground Duct Cable. By each duct cable location repaired. This will include excavation, placement of duct cable, backfill and compaction.

6.6. **Road Bore**. By the foot of road bore. This will include conduit installed.

6.7. **Install, Remove, or Replace Roadway Illumination Assembly**. By each assembly installed, removed, or replaced. This item includes all wiring and hardware connections above the foundation.

- Install Roadway Illumination Assembly (HPS)
- Remove Roadway Illumination Assembly (HPS)
- Replace Roadway Illumination Assembly (HPS)
- Install Roadway Illumination Assembly (LED)
- Remove Roadway Illumination Assembly (LED)
- Replace Roadway Illumination Assembly (LED)

6.8. **Install, Remove, or Replace Underpass Luminaire**. By each luminaire installed, removed, or replaced.

- Install Underpass Luminaire (HPS)
- Remove Underpass Luminaire (HPS)
- Replace Underpass Luminaire (HPS)
- Install Underpass Luminaire (LED)
- Remove Underpass Luminaire (LED)
- Replace Underpass Luminaire (LED)

6.9. **Install, Remove, or Replace Induction Fluorescent Fixture**. By each fixture installed, removed, or replaced.

- Install Induction Fluorescent Fixture
- Remove Induction Fluorescent Fixture
- Replace Induction Fluorescent Fixture

6.10. **Install, Remove, or Replace Luminaire**. By each luminaire installed, removed, or replaced.

- Install Luminaire (HPS)
- Remove Luminaire (HPS)
- Replace Luminaire (HPS)
- Install Luminaire (LED)
- Remove Luminaire (LED)
- Replace Luminaire (LED)

6.11. **Replace High Mast Luminaires**. By each high mast luminaire replaced.

6.12. **Replace Luminaire Pole**. By each pole replaced.

6.13. **Replace Luminaire Arms**. By each luminaire arm replaced.

6.14. **Maintain Roadway Illumination**. By each luminaire pole maintained.

6.15. **Maintain High Mast Illumination**. By each high mast pole maintained.

6.16. **Maintain Overhead Sign Lighting**. By each sign light maintained.

6.17. **Maintain Underpass Fixture**. By each underpass fixture maintained.

6.18. **Maintain Induction Fluorescent Fixture**. By each induction fluorescent fixture maintained.

6.19. **Scheduled Preventive Maintenance (Roadway Illumination Assembly)**. By each roadway illumination pole. (Replacing lamp and ballast is subsidiary to this bid item.)

6.20. **Scheduled Preventive Maintenance (High Mast Assembly)**. By each high mast pole regardless of the number of luminaires on the ring. (Replacing lamps and ballast is subsidiary to this bid item.)

6.21. **Replace Electrical Service**. By the each electrical service replaced.

6.22. **Replace Service Pole (Timber, Steel, or Concrete)**. By each service pole replaced.

- Replace Timber Service Pole
- Replace Steel Service Pole
- Replace Concrete Service Pole

6.23. **Install Ground Box**. By each ground box installed.

- Install Ground Box
- Install Ground Box w/ Apron

6.24. **Remove Ground Box**. By each ground box removed.

6.25. **Install Foundation**. By each foundation installed.

6.26. **Remove Foundation**. By each foundation removed.

6.27. **Replace Transformer Base**. By each base replaced.

6.28. **Replace Transformer Base Cover**. By each cover replaced.

6.29. **Replace Hand Hole Cover**. By each cover replaced.

6.30. **Install Ground Rod**. By each ground rod installed.

6.31. **Replace Ballast**. By each ballast replaced.

6.32. **Replace Ballast (High Mast Lighting)**. By each high mast ballast replaced.

6.33. **Install or Replace Fused Disconnect**. By each fused disconnect installed or replaced.

- Install Fused Disconnect
- Replace Fused Disconnect

6.34. **Replace Lamp Socket**. By each lamp socket replaced for pole mounted, underpass, and wall pack fixtures.

- Replace Lamp Socket for pole mounted fixtures
- Replace Lamp Socket for underpass fixtures
- Replace Lamp Socket for wall pack fixtures
- Replace Lamp Socket for high mast fixture

6.35. **Replace Lamp**. By each lamp replaced for pole mounted, underpass, and wall pack fixtures.

- Replace Lamp for pole mounted fixtures
- Replace Lamp for underpass fixtures
- Replace Lamp for wall pack fixtures

6.36. **Replace Lamp (High Mast Lighting)**. By each lamp replaced.

6.37. **Replace Wall Pack Luminaire**. By each wall pack replaced.

6.38. **Replace Lens**. By each lens replaced

- Replace Lens for pole mounted fixture
- Replace Lens for underpass fixture
- Replace Lens for wall pack fixture

- Replace Lens for high mast fixture

6.39. **Replace Wall Pack Guard**. By each guard replaced.

6.40. **Replace Fuse**. By each fuse replaced.

6.41. **Replace Fuse Holder**. By each fuse holder replaced.

6.42. **Replace Breakaway Fuse Holder**. By each breakaway fuse holder replaced.

6.43. **Replace Starting Aid**. By each starting aid replaced.

6.44. **Replace Photocell and Bracket**. By each photocell and bracket replaced.

6.45. **Replace Control Transformer**. By each transformer replaced.

- Replace Control Transformer for High Mast
- Replace Control Transformer for Electrical Service

6.46. **Replace Control Circuit**. By each control circuit replaced.

- Replace Control Circuit for High Mast
- Replace Control Circuit for Electrical Service

6.47. **Replace Aviation Warning Fixture**. By each obstruction fixture replaced.

6.48. **Replace Aviation Warning Lamp**. By each obstruction lamp replaced.

6.49. **Replace Hand-Off-Auto Switch**. By each H-O-A control switch replaced.

6.50. **Replace Contactor**. By each electromagnetic contactor replaced.

6.51. **Replace Meter Base**. By each meter base replaced.

6.52. **Replace Time Clock**. By each time clock replaced.

6.53. **Replace Breaker Panel**. By each breaker panel replaced.

6.54. **Install or Replace Circuit Breaker**. By each circuit breaker installed or replaced.

- Install Circuit Breaker
- Replace Circuit Breaker

6.55. **Replace Flexible Power Cable or Cord**. By foot of cable or cord replaced.

6.56. **Replace Twist Lock Connector**. By each twist lock connector replaced.

6.57. **Replace Safety Lanyard**. By foot of chain replaced. Associated hardware is considered subsidiary to this item.

6.58. **Raise and Lower Ring (High Mast Lighting)**. By each ring raised and lowered (not part of scheduled preventive maintenance).

6.59. **Restrap Existing Conduit**. By each strap installed.

6.60. **Replace Missing Nuts, Washers, and Other Hardware**. By each nut, washer, or miscellaneous hardware replaced.

6.61. **Troubleshoot for Repairs**. By the man-hour of troubleshooting.

6.62. **Project Inspections**. By the month.

6.63. **Install or Replace Safety Switch.** By each safety switch installed or replaced.

- Install Safety Switch
- Replace Safety Switch

6.64. **Replace 5/16 in. Wire Rope.** By each 5/16 in. wire rope with swaged terminals replaced.

6.65. **Replace 3/8 in. Wire Rope.** By each 3/8 in. wire rope with swaged terminals replaced.

6.66. **Replace High Mast Winch.** By each winch replaced.

6.67. **Replace Wire Rope Pulley.** By each wire rope pulley replaced.

6.68. **Replace Electrical Cable Pulley.** By each electrical cable pulley replaced.

6.69. **Install or Replace Access Hole Cover**. By each access cover installed or replaced.

- Install Access Hole Cover
- Replace Access Hole Cover

6.70. **Replace High Mast Springs.** By each high mast spring set replaced.

6.71. **Remove and Reinstall High Mast Pole for Repairs.** By each high mast pole removed and reinstalled.

7. PAYMENT

The work performed and the materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit prices bid for the various designations. This price is full compensation for furnishing all material, equipment, labor, fines, tools, and incidentals necessary to complete the work.

Lane closures will be paid for under Special Specification "Lane Closures."

Special Specification 6001
Portable Changeable Message Sign

1. DESCRIPTION

Furnish, operate, and maintain portable trailer mounted changeable message sign (PCMS) units.

2. MATERIALS

Furnish new or used material in accordance with the requirements of this Item and the details shown on the plans. Provide a self-contained PCMS unit with the following:

- Sign controller
- Changeable Message Sign
- Trailer
- Power source

Paint the exterior surfaces of the power supply housing, supports, trailer, and sign with Federal Orange No. 22246 or Federal Yellow No. 13538 of Federal Standard 595C, except paint the sign face assembly flat black.

2.1. **Sign Controller**. Provide a controller with permanent storage of a minimum of 75 pre-programmed messages. Provide an external input device for random programming and storage of a minimum of 75 additional messages. Provide a controller capable of displaying up to 3 messages sequentially. Provide a controller with adjustable display rates. Enclose sign controller equipment in a lockable enclosure.

2.2. **Changeable Message Sign**. Provide a sign capable of being elevated to at least 7 ft. above the roadway surface from the bottom of the sign. Provide a sign capable of being rotated 360° and secured against movement in any position.

Provide a sign with 3 separate lines of text and 8 characters per line minimum. Provide a minimum 18 in. character height. Provide a 5 × 7 character pixel matrix. Provide a message legibility distance of 600 ft. for nighttime conditions and 800 ft. for normal daylight conditions. Provide for manual and automatic dimming light sources.

The following are descriptions for 3 screen types of PCMS:

- **Character Modular Matrix**. This screen type comprises of character blocks.
- **Continuous Line Matrix**. This screen type uses proportionally spaced fonts for each line of text.
- **Full Matrix**. This screen type uses proportionally spaced fonts, varies the height of characters, and displays simple graphics on the entire sign.

2.3. **Trailer**. Provide a 2 wheel trailer with square top fenders, 4 leveling jacks, and trailer lights. Do not exceed an overall trailer width of 96 in. Shock mount the electronics and sign assembly.

2.4. **Power Source**. Provide a diesel generator, solar powered power source, or both. Provide a backup power source as necessary.

2.5. **Cellular Telephone**. When shown on the plans, provide a cellular telephone connection to communicate with the PCMS unit remotely.

3. CONSTRUCTION

Place or relocate PCMS units as shown on the plans or as directed. The plans will show the number of PCMS units needed, for how many days, and for which construction phases.

Maintain the PCMS units in good working condition. Repair damaged or malfunctioning PCMS units as soon as possible. PCMS units will remain the property of the Contractor.

4. MEASUREMENT

This Item will be measured by each PCMS or by the day used. All PCMS units must be set up on a work area and operational before a calendar day can be considered measurable. When measurement by the day is specified, a day will be measured for each PCMS set up and operational on the worksite.

5. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Portable Changeable Message Sign." This price is full compensation for PCMS units; set up; relocating; removing; replacement parts; batteries (when required); fuel, oil, and oil filters (when required); cellular telephone charges (when required); software; and equipment, materials, tools, labor, and incidentals.

Special Specification 6005

Testing, Training, Documentation, Final Acceptance, and Warranty

1. DESCRIPTION

Perform or furnish testing, training, documentation, final acceptance, and warranty on the applicable equipment or systems.

2. TESTING

Unless otherwise shown on the plans, perform the following tests on the applicable equipment or systems.

2.1. **Test Procedures Documentation**. Provide 5 copies of the test procedures and blank data forms 60 days prior to testing for each test required on this project. Include the sequence of the tests in the procedures. The Engineer will approve test procedures prior to submission of equipment for tests. Conduct all tests in accordance with the approved test procedures.

Record test data on the data forms, as well as quantitative results. Ensure the data forms are signed by an authorized representative (company official) of the equipment manufacturer. Submit 1 copy of the completed and signed data forms for acceptance or rejection of the test or equipment.

2.2. **Design Approval Test**. Conduct a Design Approval Test on randomly selected units from the prototype design manufacturing run. If only 1 design prototype is manufactured, perform this test on that unit. If supplying multiple types of the equipment, provide and test a sample of each type.

Certification from an independent testing laboratory of a successfully completed Design Approval Test is acceptable. Ensure that the testing by this laboratory is performed in accordance with the requirements of this specification. Failure of independent tests to comply with the requirements of this specification will be grounds for rejection of any certification.

Notify the Engineer 10 working days before conducting this testing. The Department may witness all the tests. Perform the following tests:

2.2.1. **Power Service Transients**. The equipment must meet the performance requirements, specified in the parent specification, when subjected to the power service transients as specified in Section 2.2.7.2, “Transient Tests (Power Service)” of the NEMA TS 2 standard, latest edition.

2.2.2. **Temperature and Condensation**. The equipment must meet the performance requirements, specified in the parent specification, when subjected to the following conditions in the order specified below:

- Stabilize the equipment at -30°F and test as specified in Sections 2.2.7.3., “Low-Temperature Low-Voltage Tests” and 2.2.7.4., “Low-Temperature High-Voltage Tests” of the NEMA TS 2 standard, latest edition.
- Allow the equipment to warm up to room temperature in an atmosphere having relative humidity of at least 40%. Operate the equipment for 2 hr., while wet, without degradation or failure.
- Stabilize the equipment at 165°F and test as specified in Sections 2.2.7.5., “High-Temperature High Voltage Tests” and 2.2.7.6, “High-Temperature Low-Voltage Tests” of the NEMA TS 2 standard, latest edition.

2.2.3. **Relative Humidity**. The equipment must meet the performance requirements, specified in the parent specification, within 30 min. of being subjected to a temperature of 165°F and a relative humidity of 18% for 48 hr.

2.2.4. **Vibration**. The equipment must show no degradation of mechanical structure, soldered components, or plug-in components and must operate in accordance with the manufacturer's equipment specifications after being subjected to the vibration tests as described in Section 2.2.8, “Vibration Test,” of the NEMA TS 2 standard, latest edition.

2.2.5. **Power Interruption**. The equipment must meet the performance requirements, specified in the parent specification, when subjected to nominal input voltage variations as specified in Section 2.2.10, “Power Interruption Test,” of the NEMA TS 2 standard, latest edition.

2.3. **Demonstration Test**. Conduct a Demonstration Test on applicable equipment at an approved Contractor facility. Notify the Engineer 10 working days before conducting this testing. The Department may witness all the tests. Perform the following tests:

2.3.1. **Examination of Product**. Examine each unit carefully to verify that the materials, design, construction, markings and workmanship comply with the requirements of the parent specification.

2.3.2. **Continuity Tests**. Check the wiring to determine conformance with the requirements of the appropriate paragraphs in the parent specification.

2.3.3. **Operational Test**. Operate each unit for at least 15 min. to permit equipment temperature stabilization and an adequate number of performance characteristics to ensure compliance with the requirements of the parent specification.

2.4. **Stand-Alone Tests**. Conduct a Stand-Alone Test for each unit after installation. The test must exercise all stand-alone (non-network) functional operations. Notify the Engineer 5 working days before conducting this test. The Department may witness all the tests.

2.5. **System Integration Test**. Conduct a System Integration Test on the complete functional system. Demonstrate all control and monitor functions for each system component for 72 hr. Supply 2 copies of the System Operations manual before the System Integration Test. Notify the Engineer 10 working days before conducting this testing. The Department may witness all the tests.

2.6. **Final Acceptance Test**. Conduct a Final Acceptance Test on the complete functional system. Demonstrate all control, monitor, and communication requirements for 90 days. The Engineer will furnish a Letter of Approval stating the first day of the Final Acceptance Test. The completion of the Final Acceptance Test occurs when system downtime due to mechanical, electrical, or other malfunctions to equipment furnished or installed does not exceed 72 hr. and any individual points of failure identified during the test period have operated free of defects as required in Section 2.7.5., “Consequences of Final Acceptance Test Failure.”

2.7. **Consequences of Test Failure**. If a unit fails a test, submit a report describing the nature of the failure and the actions taken to remedy the situation prior to modification or replacement of the unit. If a unit requires modification, correct the fault and then repeat the test until successfully completed. Correct minor discrepancies within 30 days of written notice to the Engineer. If a unit requires replacement, provide a new unit and then repeat the test until successfully completed. Major discrepancies that will substantially delay receipt and acceptance of the unit will be sufficient cause for rejection of the unit.

If a failure pattern develops in similar units within the system, implement corrective measures, including modification or replacement of units, to all similar units within the system as directed. Perform the corrective measures without additional cost or extension of the contract period.

2.7.1. **Consequences of Design Approval Test Failure**. If the equipment fails the Design Approval Test, correct the fault and then repeat the Design Approval Test until successfully completed.

2.7.2. **Consequences of Demonstration Test Failure**. If the equipment fails the Demonstration Test, correct the fault and then repeat the Demonstration Test until successfully completed.

2.7.3. **Consequences of Stand-Alone Test Failure**. If the equipment fails the Stand-Alone Test, correct the fault and then repeat the Demonstration Test until successfully completed.

2.7.4. **Consequence of System Integration Test Failure**. If the equipment fails the System Integration Test, correct the fault and then repeat the Systems Integration Test until successfully completed.

2.7.5. **Consequences of Final Acceptance Test Failure**. If a defect within the system is detected during the Final Acceptance Test, document and correct the source of failure. Once corrective measures are taken, monitor the point of failure until a consecutive 30 day period free of defects is achieved.

If after completion of the initial test period, the system downtime exceeds 72 hr. or individual points of failure have not operated for 30 consecutive days free of defects, extend the test period by an amount of time equal to the greater of the downtime in excess of 72 hr. or the number of days required to complete the performance requirement of the individual point of failure.

3. TRAINING

When required on the plans, provide a minimum of 24 hr. of instruction to 10 designated personnel in the operation and maintenance procedures of equipment or systems installed. Provide the training during installation, testing, and integration. Provide the training through practical demonstrations, seminars, and other related technical procedures.

Furnish a training session agenda, a complete set of training material (manuals and schematics), and the names and qualifications of proposed instructors for approval 60 days before the training. Provide a training location. Provide 1 copy of the course material for each person. Provide training in the following areas of interest and as shown on the plans:

- The “Hands-on” operation for each type of equipment.
- Explanation of all system commands, their function and usage.
- Required preventative maintenance procedures.
- All equipment servicing procedures.
- System “troubleshooting”/problem identification procedures.

4. DOCUMENTATION

Provide “as-built” documentation for the entire system and all of its individual components. Supply one (1) 11 in. x 17 in. reproducible copy of the wiring diagrams. Supply three (3) copies of the following in a manual for each equipment component:

- Complete and accurate schematic diagrams.
- Complete and accurate cabinet, enclosure, and building wiring diagrams.
- Complete installation procedures.
- Complete performance specifications (functional, electrical, mechanical and environmental) on the unit.
- Complete parts list including names of vendors for parts not identified by universal part numbers such as JEDEC, RETMA, or EIA.
- Pictorial of component layout on circuit board.
- Complete maintenance and trouble-shooting procedures.
- Complete stage-by-stage explanation of circuit theory and operation.
- Complete and detailed system operations manuals.

Furnish additional information as shown on the plans.

5. FINAL ACCEPTANCE

Final acceptance is made when all work is complete, the system has successfully completed all test requirements, and the Engineer, in writing, accepts all work for the work locations in the Contract in accordance with Article 5.12., “Final Acceptance.” Final acceptance relieves the Contractor from further Contract responsibilities.

6. WARRANTY

Guarantee equipment furnished and installed to perform according to the manufacturer’s published specifications. Warrant equipment against defects or failure in design, materials, and workmanship in accordance with the manufacturer’s standard warranty. Supply equipment with no less than 95% of the manufacturer’s warranty remaining on the date that equipment invoices are submitted for final payment. Any equipment with less than 95% warranty remaining will be rejected.

The Contractor will warrant or guarantee all such electronic, electrical, and mechanical equipment, materials, technical data, and products furnished and installed for a period of 1 yr. after final acceptance of the project by the Department. The Contractor’s warranty or guarantee must provide for the “on-site” repair or replacement, at the Contractor’s option, within 2 working days and at no cost to the Department.

Once the Contractor’s warranty or guarantee expires, assign to the Department any manufacturer’s standard warranty or guarantee coverage still remaining on all such electronic, electrical, and mechanical equipment, materials, technical data, and products furnished for and installed on the project. Repair or replace defective equipment, at the manufacturer’s option, at no cost to the Department.

7. MEASUREMENT AND PAYMENT

The work performed, materials furnished, equipment, labor, tools, and incidentals will not be measured or paid for directly but will be considered subsidiary to bid items of the Contract.

Special Specification 6006
Electronic Components

1. DESCRIPTION

Use electronic components to manufacture electronic equipment.

2. MATERIALS AND CONSTRUCTION METHODS

Use electronic components that comply with Electronic Industries Association (EIA) and Joint Electronic Device Engineering Council (JEDEC) Specifications. Provide industry standard electronic components available from several manufacturers. When special monolithic integrated circuits are necessary for cost-effective designs, waiving the multi-source requirements will be as directed.

Design the electronic circuitry to ensure an adjustment range from normal adjustment settings of variable components. Provide a range of adjustment to compensate for composite variations in the associated circuitry due to changes in part values during the normal or specified life of the device. Ensure the range of adjustment can compensate for variations in replacement parts within the specified tolerances. Unless otherwise shown on the plans, design the components to be under operating conditions 24 hr. a day for 10 yr. Derate electronic components by 20% with regard to ambient temperature, applied voltage, and power dissipation.

On electronic components weighing more than 2 oz., use supports other than the component's pins or electrical connectors. Solder electronic components of 2 or more leads in place. Mark the circuit reference symbol next to the component.

Meet the above requirements and satisfy the following specific requirements for the different components:

2.1. **Capacitors**. Provide industrial grade capacitors. Insulate the capacitors. Mark capacitors with their capacitance value, working voltage, and polarity.

Provide capacitor encasements resistant to cracking, peeling, and discoloration due to humidity and changes in temperature. Provide electrolytic capacitors capable of operating at least 185°F. Do not use electrolytic capacitors of less than 1.0 microfarad.

Use a clamp or fastener to support a capacitor to avoid damage by shock or vibration. Use a capacitor with a specific ripple or AC voltage rating, if possibly subjected to a ripple voltage in excess of 10% of the actual DC voltage across the capacitor. Use an aluminum electrolytic capacitor only when continually energized.

2.2. **Diodes**. If low forward drop is required in logic circuit applications, furnish justification for use of Germanium diodes prior to incorporation in the design. Mark diodes with the JEDEC part number, using an industry approved color code or clearly legible printing. Indicate the diode polarity on the diode case by the use of the diode symbol, by the 360° band on the cathode end, or by the shape of case.

2.3. **Indicators**. Use solid-state (LED) indicators with a useful life at least 25,000 hr.

2.4. **Integrated Circuits**. Print the manufacturer's part number and any information required to install the integrated circuit assembly upon the package. Test integrated circuits with at least 1 test from each group below:

2.4.1. **Group 1:**

- Stabilization Bake
- Temperature Cycling
- Power Burn-in

2.4.2. **Group 2:**

- Functional test with the device at the manufacturer's maximum specified temperature
- Static and dynamic test per manufacturer's data sheet

2.5. **Potentiometers and Rheostats**. Use industrial grade potentiometers. Use potentiometers with a power rating at least 100% greater than the maximum power requirements of the circuit.

2.6. **Printed Circuit Boards**.

2.6.1. **Design, Fabrication and Mounting**. Use NEMA Grade G-10 glass epoxy or equivalent for printed circuit boards (refer to NEMA Publications No. L1 1-1982, Industrial Laminated Thermosetting Products). Provide a nominal thickness of 1/32 in. for circuit boards not exceeding 2 in. in any dimension. Provide a nominal thickness of 1/16 in. for circuit boards exceeding 2 in. in any dimension.

Coat the printed circuit board assembly with a protective coating to combat mildew, moisture, and fungus. Plate the through holes that carry electrical connections from one side of the board to the other. Use 1 oz. per square foot of copper to plate through holes. Use non-corrosive material for electrical mating surfaces.

Design and fabricate printed circuit boards and the mounting of parts and assemblies in accordance with MIL-STD-275 (latest revision) except as follows:

- Mount semiconductor devices on spacers or transipads if the device dissipates more than 250 mW or if the case temperature will rise 20°F above ambient.
- Remove residual flux from the printed circuit board.
- Provide a resistance between any 2 isolated, independent conductor paths of at least 100 megohms when a 500 VDC potential is applied.

Mark operating circuit components mounted on the circuit boards. Reference the identifying characters to their respective components in the schematic diagram and in the parts list.

2.6.2. **Soldering**. Hand solder in accordance with MIL-STD-55110. Use of automatic flow soldering is acceptable.

2.7. **Relays**. Install diodes across the coils for transient suppression in DC relays. Provide replaceable relays that do not require special tools for replacement.

2.8. **Resistors**. Use fixed composition insulated resistors in accordance with the performance requirements of MIL-R-11. Provide industrial grade resistors with a 15-yr. design life. Mark with their resistance value, using EIA color codes or industry approved marking technique.

Use resistors with a 10% tolerance or better and a resistance variation of no more than 5% over the temperature range 0°F to 165°F. Do not use resistors with a power rating greater than 2 W unless special ventilation or heat sinking is provided. Insulate these resistors from the printed circuit board.

2.9. **Transistors**. Use JEDEC registered transistors. Mark the JEDEC part number on the case. Designate the emitter or collector by use of an industry approved marking technique.

2.10. **Transformers**. Mark transformers with the manufacturer's part number on the case or frame, using a Radio-Electronics-Television Manufacturers Association (RETMA) color code or numbered in a manner to facilitate proper installation.

2.11. **Switches**. Derate switch contacts 50% from their maximum current ratings.

3. MEASUREMENT AND PAYMENT

The work performed, materials furnished, equipment, labor, tools, and incidentals will not be measured or paid for directly, but will be subsidiary to the bid items of the Contract.

Special Specification 6007

Intelligent Transportation System (ITS) Fiber Optic Cable

1. DESCRIPTION

Furnish, install, relocate and remove Intelligent Transportation System (ITS) fiber optic cable, fiber patch panels and splice enclosures as shown on the plans.

2. MATERIALS

2.1. **General Requirements.** Provide, assemble, fabricate and install materials that are new, corrosion resistant, and in accordance with the details shown on the plans and in these Specifications.

Furnish, install, splice, and test all new fiber optic cable. Provide all splicing kits, fiber optic cable caps, connectors, moisture or water sealants, terminators, splice trays, fiber optic jumpers, pig tails, fiber patch panels, fiber interconnect housing, and accessories necessary to complete the fiber optic network. Provide all equipment necessary for installation, splicing, and testing.

2.2. **Cable Requirements.** Furnish all-dielectric, dry-filled, gel-free, loose tube fiber optic cable, with low water peak, suitable for underground conduit environments or aerial applications.

Furnish self-supporting, all-dielectric, dry-filled, gel-free, loose tube fiber optic cable, with low water peak suitable for aerial applications when not lashing to strand cable.

All fiber optic cable furnished must have a design life of 20 yr. when installed to the manufacturer's specifications.

Splice fiber optic cables in ground boxes, field cabinets, or buildings. Terminate fiber optic cables in field cabinets and buildings that comply with the details shown on the plans and in this Specification.

Provide all fiber optic cable from the same manufacturer and the manufacturer is International Organization for Standardization (ISO) 9001 certified. Ensure the cables meet or exceed United States Department of Agriculture Rural Utilities Service (RUS) CFR 1755.900, American National Standards Institute/Insulated Cable Engineers Association (ANSI/ICEA) S-87-640, and Telecommunications Industry Association/Electronic Industries Alliance (TIA/EIA)-492-CAAB standard.

2.3. **Optical Requirements**.

2.3.1. **Optical Fiber.** Provide ITU G.652 single mode fiber optic cable with a core diameter of 8.3 ± 0.7 microns and a cladding diameter of 125 ± 0.7 microns. Provide optical fiber made of glass consisting of a silica core surrounded by concentric silica cladding, free of imperfections and inclusions.

2.3.2. **Core/Clad Concentricity.** Provide an offset between the center of the core and cladding less than 0.5 microns.

2.3.3. **Mode Field Diameter.** Provide single mode fiber optic cable with the effective area or Mode Field Diameter of the fiber must be 9.2 ± 0.4 µm at 1310 nm and 10.5 ± 1.0 µm at 1550 nm.

2.3.4. **Primary Coating.** Provide fiber with a coating diameter of 250 ± 15 microns.

2.3.5. **Attenuation.** Provide single mode fiber optic cable with nominal attenuation of 0.35 dB/km maximum at a wavelength of 1310 nm and nominal attenuation of 0.25 dB/km maximum at a wavelength of 1550 nm.

Attenuation at water peak must be less than 0.35 dB/km at 1383 nm.

2.3.6. **Bandwidth and Dispersion.** Provide single mode fiber optic cable with a maximum dispersion of:

- 3.2 ps/nm-km at a wavelength of 1310 nm, and
- 18 ps/nm-km at a wavelength of 1550 nm.

Zero dispersion wavelength must be between 1300 nm and 1324 nm and the zero dispersion slope at the zero dispersion wavelength must be less than 0.092 ps/($nm^2 \cdot km$).

The cutoff wavelength must be less than 1260 nm for single mode fibers specified to operate at 1310 nm. The cutoff wavelength must be less than 1480 for single mode fibers specified to operate only at 1550 nm or higher.

The macrobend attenuation per 100 turns must not exceed 0.05 dB at 1310 nm and 1550 nm.

2.3.7. **Mechanical Requirements(Tensile Strength).** Provide a cable withstanding a pulling tension of 600 lbf without increasing attenuation by more than 0.8 dB/mi when installing in underground conduit systems in accordance with EIA-455-33A. Conduct an impact test in accordance with TIA/EIA-455-25C (FOTP-25) and a compression load test in accordance with TIA/EIA-455-41A (FOTP-41).

For all-dielectric self-supporting cable (ADSS) and other self-supporting cables, meet tensile strength requirements in accordance with Section 25, Loading of Grades B and C, of National Electric Safety Code (NESC), for the maximum span and sag information as shown in the plans for aerial construction.

2.3.8. **Bend Radius.** Provide a cable withstanding a minimum bending radius of 10 times its outer diameter during operation, and 20 times its outer diameter during installation, removal and reinstallation without changing optical fiber characteristics. Test the cable in accordance with EIA-455-33A.

2.3.9. **Buffering.** Use a buffering tube or jacket with an outer diameter of 1.0 to 3.0 mm containing 12 individual fiber strands. The fibers must not adhere to the inside of the buffer tube.

2.3.10. **Color Coding.** Provide fiber and buffer tubes with a color coating applied to it by the manufacturer. Coating must not affect the optical characteristics of the fiber. Provide color configuration in accordance with TIA/EIA-598 as follows:

- 1. Blue
- 2. Orange
- 3. Green
- 4. Brown
- 5. Slate
- 6. White
- 7. Red
- 8. Black
- 9. Yellow
- 10. Violet
- 11. Rose
- 12. Aqua

3. EQUIPMENT

3.1. **Cable Type.** Provide cables with a reverse oscillation or planetary stranding structure.

Jacket construction and group configuration should separate at splice points to cut and splice 1 set of fibers while the others remain continuous. All cable jackets must have a ripcord to aid in the removal of the outer jacket. Submit cable designs for approval.

Strand loose buffer tubes around a dielectric central anti-buckling strength member. Provide dielectric aramid or fiber glass strength members with specified strength for the cable. Provide cable with a water-blocking material, which is non-hygroscopic, non-nutritive to fungus, non-conductive, non-toxic, and homogeneous. The water blocking material must comply with TIA/EIA-455-81B and 455-82B as well as TIA/EIA-455-98.

Ensure a polyethylene inner jacket is applied over the cable core, and that the entire cable is enclosed with a polyethylene outer jacket. Ensure the outer jacket contains black carbon to provide UV protection for the cable. Ensure each cable is marked with the manufacturer's name, the date of manufacture (month/year), the fiber count (example 48F SM), and sequential length markings at maximum 2 ft. increments, measured in U.S. units.

For aerial installation, provide standard fiber optic cable lashed to steel messenger cable or ADSS in accordance with the Institute of Electrical and Electronics Engineers (IEEE) 1222 Standard for Testing and Performance for All-Dielectric Self-Supporting (ADSS) Fiber Optic Cable for Use on Electric Utility Power Lines, or most current version. Provide ADSS cable in accordance with the maximum span distance, weather load rating, and allowable sag as shown on the plans. "Figure 8" self-supporting cable with integrated messenger cable within the outer jacket for aerial installation is acceptable.

3.1.1. **Cable Size.** Furnish cables with a maximum diameter not exceeding 19 mm.

3.1.2. **Environmental Requirements.** Provide cable that functions in a temperature range from -40°F to 158°F.

3.2. **Fiber Optic Accessories.**

3.2.1. **Splice Enclosures.** Furnish and install 1 of 3 types of underground splice enclosures at locations shown on the plans to accommodate the cables being spliced at that point. The types are as follows:

- Type 1: 4 cable entry ports total – 2 ports to accommodate backbone fiber of up to 144 fibers and 2 ports for drop cables of up to 48 fibers,
- Type 2: 6 cable entry ports total – 4 to accommodate backbone or arterial cables of up to 144 fibers and 2 ports for drop cables of up to 48 fibers, and
- Type 3: 8 cable entry ports total – 4 to accommodate backbone or arterial cables of up to 144 fibers and 4 ports for drop cables of up to 48 fibers.

Provide the end cap of the canister splice closure with re-enterable quick-seal cable entry ports to accommodate additional branch cables or backbone cables. Provide fiber optic splice enclosures with strain relief, splice organizers, and splice trays from the same manufacturer as the splice enclosure. Select the appropriate splice enclosure type based on the number of splices called for in the plans. Suspend all splice closures off floor of the ground box and secure to cable rack assembly on side wall of ground box.

For end of reel splicing, use a fiber optic splice enclosure sized to accommodate full cable splice in one enclosure. Fiber optic splice enclosure must be of the same manufacturer as other supplied on a project. Splice enclosure and fusion splicing required for end of reel will be incidental to the fiber optic cable.

Comply with the Telcordia Technologies' GR-711-CORE standard and all applicable NEC requirements.

Contain all optical fiber splices within a splice enclosure, providing storage for fiber splices, nonspliced fiber, and buffer tubes. Provide sufficient space inside the enclosure to prevent microbending of buffer tubes when coiled.

Ensure that the splice enclosure maintains the mechanical and environmental integrity of the fiber optic cable, encases the sheath opening in the cable, and organizes and stores optical fiber. Ensure all hinges and latching devices are stainless steel or of a non-corrosive material designed for harsh environments. Ensure that the enclosure is airtight and prevents water intrusion. Ensure that splice enclosures allow re-entry and are hermetically sealed to protect internal components from environmental hazards and foreign material such as moisture, dust, insects, and UV light.

3.2.2. **Field Rack Mount Splice Enclosures.** Provide a 19 in. EIA rack mounted splice enclosure module to hold spliced fibers as shown in the plans inside field equipment cabinets or buildings.

Splice or terminate fibers inside rack mounted fiber optic splice enclosures. Provide an enclosed unit designed to house a minimum of 4 cables, sized to accommodate at a minimum the cables shown on the plans plus future expansion.

Provide splice enclosures containing mounting brackets with a minimum of 4 cable clamps. Install cable according to manufacturer recommendations for the cable distribution panel.

3.2.3. **Fiber Patch Panels.** Provide fiber patch panels that are compatible with the fiber optic cable being terminated and color coded to match the optical fiber color scheme. Coil and protect a maintenance loop of at least 5 ft. of buffer tube inside the rack mount enclosure, patch panel, or splice tray. Allow for future splices in the event of a damaged splice or pigtail.

3.2.3.1. **Cabinet.** Terminate or splice fibers inside the compact and modular fiber patch panel in the cabinet. Provide fiber patch panel for installation inside a 19 in. EIA rack and sized appropriately to accommodate the fiber terminations shown on the plans or as directed by the Engineer. Provide each patch panel housing with pre-assembled compact modular snap-in simplex connector panel modules, each module having a minimum of 6 fiber termination/connection capabilities. Provide modules with a removable cover having 6 pre-connectorized fiber pigtails, interconnection sleeves, and dust caps installed by the manufacturer. Provide a 12 fiber or greater fusion splice tray capability housing, each tray holding 12 fusion splices as shown in the plans. Stack splice trays on a rack to permit access to individual trays without disturbing other trays. Locate splice trays in a rack within a pull-out shelf. Protect the housing with doors capable of pivoting up or down. Document the function of each terminated/spliced fiber, along with the designation of each connector on labels or charts located either on the inside or outside of the housing door. Provide labels or charts that are UV resistant design for harsh environments and used inside field equipment cabinets. Use permanent marker or method of identification that will withstand harsh environments. Provide each housing with strain relief. Terminate single mode fiber optic cable with SC connectors to the patch panels, unless otherwise shown on the plans.

Install the fiber patch panel as an integral unit as shown on the plans.

3.2.3.2. **Building.** Provide a fiber patch panel with a modular design allowing interchangeability of connector panel module housing and splice housing within the rack, as shown on the plans.

Provide the number of single mode fibers, connector panel module housings, and splice housings for the patch panel unit in the building as shown on the plans.

Provide a fiber patch panel unit, installed at a height less than 7 ft., capable of housing 8 connector panel module housings or 8 splice housings. Protect the housing with doors capable of pivoting up or down and sliding into the unit.

Provide 12 snap-in simplex connector panel modules with each connector panel module housing, each module having 6 fiber termination/connector capabilities. Use a pre-assembled compact modular unit with a removable cover for the snap-in simplex connector panel module having 6 pre-connectorized fiber pigtails, interconnection sleeves, and dust caps installed by the manufacturer. Provide each connector panel module housing with a jumper routing shelf, storing up to 5 ft. (minimum) of cable slack for each termination within the housing. Provide the fiber distribution unit with strain relief.

Provide splice enclosure with 24 fusion splice tray capabilities, each splice tray holding 12 or more fusion splices. Stack splice trays on a rack to permit access to individual trays without disturbing other trays. Locate the rack on a pull-out shelf.

Document the function of each terminated/spliced fiber, along with the designation of each connector on labels or charts located either on the inside or outside of the housing door. Provide labels or charts that are UV resistant design for harsh environments and used inside field equipment cabinets. Use permanent marker or method of identification that will withstand harsh environments. Also provide documentation of the function of each terminated or spliced fiber along with the designation of each connector on charts or

diagrams matching the fiber patch panel configuration and locate inside cabinet document drawer. Provide documentation at the conclusion of fiber terminations and splicing.

Allow terminations only in the fiber interconnect housings placed in the cabinets as shown on the plans or as directed.

3.2.4. **Splice Trays**. Use splice tray and fan-out tubing kit for handling each fiber. Provide a splice tray and 12 fiber fan-out tubing with each housing for use with the 250 microns coated fiber. The fan-out will occur within the splice tray (no splicing of the fiber required). Allow each tube to fan out each fiber for ease of connectorization. Label all fibers in splice tray on a log sheet securing it to the inside or outside of the splice tray. Provide UV resistant log sheet suitable for harsh environments, located inside field cabinets or splice enclosures. Provide fan-out tubing with 3 layers of protection consisting of fluoropolymer inner tube, a dielectric strength member, and a 2.9 mm minimum outer protective PVC orange jacketing.

3.2.5. **Jumpers.** Provide fiber optic jumper cables to cross connect the fiber patch panel to the fiber optic transmission equipment as shown on the plans or as directed. Match the core size, type, and attenuation from the cable to the simplex jumper. Use yellow jumpers and provide strain relief on the connectors. Provide fiber with a 900 micron polymer buffer, Kevlar strength member, and a PVC jacket with a maximum outer jacket of 2.4 mm in diameter.

Provide 5 ft. long jumpers, unless otherwise shown on the plans. On the patch panel end of each jumper, provide an SC connector. On the opposite end of the jumper, provide a connector that is suitable to be connected to the fiber optic transmission equipment selected. When providing jumpers for existing equipment, provide connectors suitable to be connected to patch panels and fiber optic transmission equipment in use. All jumpers must have factory terminated connectors. Field terminations of connectors is prohibited.

3.2.6. **Fiber Optic Cable Storage Device.** Furnish fiber optic cable storage device designed to store slack fiber optic cable by means of looping back from device to device on an aerial run. Furnish storage devices that are non-conductive and resistant to fading when exposed to UV sources and changes in weather. Ensure storage devices have a captive design such that fiber-optic cable will be supported when installed in the aerial rack apparatus and the minimum bending radius will not be violated. Provide stainless steel attachment hardware for securing storage devices to messenger cable and black UV resistant tie-wraps for securing fiber-optic cable to storage device. Provide tie-wraps that do not damage fiber when securing to storage device. Ensure storage devices are stackable so multiple cable configurations are possible. Ensure cable storage devices furnished are compatible with the type of aerial cable furnished and installed. Aerial cable storage devices will be considered incidental to the installation of the fiber optic cable.

4. CONSTRUCTION

Install fiber optic cable in accordance with United States Department of Agriculture Rural Utilities Service CFR 1755.900 specifications for underground and aerial plant construction without changing the optical and mechanical characteristics of the cables.

Utilize available machinery, jacking equipment, cable pulling machinery with appropriate tension monitors, splicing and testing equipment, and other miscellaneous tools to install cable, splice fibers, attach connectors and mount hardware in cabinets employed with the above “Mechanical Requirements.” Do not jerk the cable during installation. Adhere to the maximum pulling tensions of 600 lbf and bending radius of 20 times the cable diameter or as specified by the manufacturer, whichever is greater.

Use installation techniques and fixtures that provide for ease of maintenance and easy access to all components for testing and measurements. Take all precautions necessary to ensure the cable is not damaged during transport, storage, or installation. Protect as necessary the cables to prevent damage if being pulled over or around obstructions along the ground.

Where plans call for removal of existing cable to salvage or reuse elsewhere, take care to prevent damaging the existing cable during removal adhering to all of the requirements for installation that pertain to removal.

4.1. **Packaging, Shipping, and Receiving.** Ensure the completed cable is packaged for shipment on reels. Ensure the cable is wrapped in weather and temperature resistant covering. Ensure both ends of the cable are sealed to prevent the ingress of moisture.

Securely fasten each end of the cable to the reel to prevent the cable from coming loose during transit. Provide 6 ft. of accessible cable length on each end of the cable for testing. Ensure that the complete outer jacket marking is visible on these 6 ft. of cable length. Provide each cable reel with a durable weatherproof label or tag showing the Manufacturer's name, the cable type, the actual length of cable on the reel, the Contractor's name, the contract number, and the reel number. Include a shipping record in a weatherproof envelope showing the above information and also include the date of manufacture, cable characteristics (size, attenuation, bandwidth, etc.), factory test results, cable identification number and any other pertinent information. Ensure that all cable delivered has been manufactured within 6 mo. of the delivery date. Ensure that the minimum hub diameter of the reel is at least 30 times the diameter of the cable. Provide the cable in one continuous length per reel with no factory splices in the fiber. Provide a copy of the transmission loss test results as required by the TIA/EIA-455-61 standard, as well as results from factory tests performed prior to shipping.

4.2. **Installation in Conduit.** Install fiber optic cable in conduits in a method that does not alter the optical properties of the cable. If required, relocate existing cable to allow new fiber optic cable routing in conduits.

When pulling the cable, do not exceed the installation bending radius. Use rollers, wheels, or guides that have radii greater than the bending radius. Use a lubricating compound to minimize friction. Use fuse links and breaks to ensure that the cable tensile strength is not exceeded. Measure the pulling tension with a mechanical device and mechanism to ensure the maximum allowable pulling tension of 600 lbf is not exceeded at any time during installation.

Provide a single 1/C #14 XHHW insulated tracer wire in conduit runs where fiber optic cable is installed. Provide cable that is UL listed solid copper wire with orange color low density polyethylene insulation suitable for conduit installation and with a voltage rating of 600V. When more than one fiber optic cable is installed through a conduit run, only one tracer wire is required. Fuse or join tracer wires used in backbone, arterial, and drop runs, so that you have one continuous tracer wire. Terminate tracer wire at fiber optic test markers or equipment cabinets as identified in the plans for access to conduct a continuity test. Tracer wire will be paid for under Item 620, "Electrical Conductors."

Provide flat pull cord with a minimum tensile strength of 1,250 lb. in each conduit containing fiber optic cable. A traceable pull cord, with a metallic conducting material integral to the pull cord, may be substituted for a 1/C #14 tracer wire only with approval from the Department.

Seal conduit ends with a 2 part urethane after installation of fiber optic cable.

4.3. **Cable Installation between Pull Boxes and Cabinets or Buildings.** Do not break or splice a second fiber optic cable to complete a run when pulling the cable from the nearest ground box to a cabinet or building. Pull sufficient length of cable in the ground box to reach the designated cabinet or building. Pull the cable through the cabinet to coil, splice, or terminate the cable in the cabinet or building. Do not bend the cable beyond its minimum bend radius of 20 times the diameter.

Coil and tie cable inside cabinet, building, or boxes for future splicing or termination as shown in the plans. Cut off and remove the first 10 ft. of pulled or blown fiber stored. This work is incidental to this Item. Coat the open end of the coiled cable with protective coating and provide a dust cap.

4.4. **Aerial Installation.** Use pole attachment hardware and roller guides with safety clips to install aerial run cable. Maintain maximum allowable pulling tension of 600 lb. ft. during the pulling process for aerial run cable by using a mechanical device. Do not allow cable to contact the ground or other obstructions between poles during installation. Do not use a motorized vehicle to generate cable pulling forces. Use a cable suspension

clamp when attaching cable tangent to a pole. Select and place cable blocks and corner blocks so as not to exceed the cable's minimum bending radius. Do not pull cable across cable hangers. Store 100 ft. of fiber-optic cable slack, for future use, on all cable runs that are continuous without splices or where specified on the plans. Store spare fiber optic cable on fiber-optic cable storage racks of the type compatible with the aerial cable furnished. Locate spare cable storage in the middle of spans between termination points. Do not store spare fiber-optic cable over roadways, driveways or railroads.

Install standard cable on timber poles by lashing to steel messenger cable. Provide steel messenger cable in accordance with Item 625, "Zinc Coated Steel Wire Strand." Install all-dielectric self-supporting cable (ADSS) cable on timber poles using clinching clamp with cable hanger. Install aerial run cable in accordance with these specifications and as shown on the plans.

Locate aerial fiber in accordance with the NESC, Section 23, with respect to vertical clearances over the ground, between conductors carried on different supporting structures, and required separation distance of the cable from bridges, buildings, and other structures.

4.5. **Blowing Fiber Installation.** Use either the high-air speed blowing (HASB) method or the piston method. When using the HASB method, ensure that the volume of air passing through the conduit does not exceed 600 cu. ft. per min.or the conduit manufacturer's recommended air volume, whichever is more restrictive. When using the piston method, ensure that the volume of air passing through the conduit does not exceed 300 cu. ft. per min.or the conduit manufacturer's recommended air volume, whichever is more restrictive.

4.6. **Slack Cable**. Pull and store excess cable slack inside ITS ground boxes as shown on the plans. The following are minimum required lengths of slack cable, unless otherwise directed:

- ground boxes (No Splice) - 25 ft.,
- ground boxes (With Splice) - 100 ft.,
- future splice point - 100 ft., and
- cabinets - 25 ft.

Note that the slack is to be equally distributed on either side of the splice enclosure and secured to cable storage racks within the ground boxes.

Provide proper storage of slack cable, both long term and short term. Neatly bind cables to be spliced together from conduit to splice enclosure with tape. Do not over bind by pinching cable or fiber. Ground and bond the armor when installing armored fiber optic cable. Meet NEC and NESC requirements for grounding and bonding when using armored cable.

4.7. **Removal, Relocation and Reinstallation of Fiber Optic Cable.** Remove fiber optic cable from conduit as shown on plans. Use care in removing existing fiber optic cables so as not to damage them. Provide cable removal and reinstallation procedures that meet the minimum bending radius and tensile loading requirements during removal and reinstallation so that optical and mechanical characteristics of the existing cables are not degraded. Use entry guide chutes to guide the cable out of and in to existing or proposed conduit, utilizing lubricating compound where possible to minimize cable-to-conduit friction. Use corner rollers (wheels) with a radius not less than the minimum installation bending radius of cable. Dispose of removed fiber optic cable unless plans show for it to be re-used (relocated/re-installed) or salvaged and delivered to the Department. See plans for details. Test each optical fiber in the cable for performance and for loss at existing terminations or splices prior to cutting and removal. Retest following removal and following re-installation to ensure the removal and reinstallation has not affected the optical properties of the cable. Any fiber optic cable damaged by the contractor that is to be re-used shall be replaced by the contractor at no cost to the Department with new fiber optic cable meeting the approval of the Engineer. The Engineer reserves the right to reject the fiber based on the test results.

Maintain the integrity of existing cables, conduit, junction boxes and ground boxes contiguous to the section of cables to be removed. Replace or repair any cables, conduit, junction boxes or ground boxes damaged during work at the Contractor's expense. The replacement or repair method must be approved by the Engineer, prior to implementation.

4.8. **Splicing Requirements.** Fusion splice fibers as shown on the plans, in accordance with TIA/EIA-568 and TIA/EIA-758.

Use fusion splicing equipment recommended by the cable manufacturer. Clean, calibrate, and adjust the fusion splicing equipment at the start of each shift. Use splice enclosures, organizers, cable end preparation tools, and procedures compatible with the cable furnished. Employ local injection and detection techniques and auto fusion time control power monitoring to ensure proper alignment during fusion splicing.

When approaching end of shift or end of day, complete all splicing at the location. Package each spliced fiber in a protective sleeve or housing. Re-coat bare fiber with a protective 8 RTV, gel or similar substance, prior to application of the sleeve or housing.

Perform splices with losses no greater than 0.10 dB. Use an Optical Time Domain Reflectometer (OTDR) to test splices in accordance with Section 4.13.1.1. Record splice losses on a tabular form and submit for approval.

4.9. **Termination Requirements.** Provide matching connectors with 900 micron buffer fiber pigtails of sufficient length and splice the corresponding optical fibers in cabinets where the optical fibers are to be connected to terminal equipment. Buffer, strengthen, and protect pre-terminated fiber assemblies (pigtails) with dielectric aramid yarn and outer PVC jacket to reduce mishandling that can damage the fiber or connection. Pigtails must be duplex stranding with a yellow PVC outer jacket. Fiber optic pigtails must be factory terminated with SC connectors, unless otherwise shown on the plans. When providing pigtails for existing equipment, provide connectors suitable to be connected to patch panels and fiber optic transmission equipment in use.

Connectors must meet the TIA/EIA-568 and TIA/EIA-758 standards and be tested in accordance to the Telcordia/Bellcore GR-326-CORE standard. When tested according to TIA/EIA-455-171 (FOTP-171), ensure that the connectors test to an average insertion loss of less than or equal to 0.4 dB and a maximum loss of less than or equal to 0.75 dB for any mated connector. Maintain this loss characteristic for a minimum of 500 disconnections and reconnections with periodic cleanings per EIA-455-21A (FOTP-21). Qualify and accept connectors by the connector-to-connector mating using similar fibers. Ensure that the connector operating range is -40ºF to 167ºF. Provide connectors with a yellow color body or boot.

Test connections at the patch panel and splices made between cables to pigtails with the OTDR to verify acceptable losses.

Remove 5 ft. of unused optical fibers at the ends of the system from the buffer tube(s) and place coiled fibers into a splice tray. Clean the water blocking compound from all optical fibers destined for splice tray usage.

Install cable tags at all splice points identifying key features of each cable such as cable name or origin and destination and fiber count. Ensure tags are self-laminating or water resistant. Print the information onto the tags electronically or write neatly using a permanent marker. Locate tags just prior to entrance into splice enclosure.

4.10. **Mechanical Components.** Provide stainless steel external screws, nuts and locking washers. Do not use self-tapping screws unless approved. Provide corrosion resistant material parts and materials resistant to fungus growth and moisture deterioration.

4.11. **Experience Requirements**.

4.11.1. **Installing Fiber Optic Cable.** The Contractor or designated subcontractor involved in the installation of the fiber optic cable must meet the experience requirements in accordance with the following:

- minimum of 3 yr. of continuous existence offering services in the installation of fiber optic cable through an outdoor conduit system or aerial and terminating in ground boxes, field cabinets or enclosures or buildings, and

- completed a minimum of 3 projects where the personnel pulled a minimum of 5 mi. in length of fiber optic cable through an outdoor conduit system of aerial for each project. The completed fiber optic cable systems must have been in continuous satisfactory operation for a minimum of 1 yr.

4.11.2. **Splicing and Testing of Fiber Optic Cable.** The Contractor or designated subcontractor involved in the splicing and testing of fiber optic cable must meet the experience requirements in accordance with the following:

4.11.2.1. **Minimum Experience**. 3 yr. continuous existence offering services in the fields of fusion splicing and testing of fiber optic cable installed through a conduit system and terminating in ground boxes, field cabinets or enclosures or buildings. Experience must include all of the following:

- termination of a minimum of 48 fibers within a fiber distribution frame,
- OTDR testing and measurement of end to end attenuation of single mode and multimode fibers,
- system troubleshooting and maintenance,
- training of personnel in system maintenance,
- use of water-tight splice enclosures, and
- fusion splicing of fiber optic cable which meet the tolerable decibel (dB) losses within the range of 0.05 dB – 0.10 dB for single mode.

4.11.2.2. **Completed Projects**. A minimum of 3 completed projects where the personnel performed fiber optic cable splicing and terminations, system testing, system troubleshooting and maintenance during the course of the project and provided training on system maintenance. Each project must have consisted of a minimum 5 mi. of fiber optic cable installed, measured by project length not linear feet of fiber installed. The completed fiber optic cable systems must have been in continuous satisfactory operation for a minimum of 1 yr.

4.12. **Documentation Requirements.** Provide a minimum of 2 complete sets of fiber optic equipment submittal literature documenting compliance with the requirements of this Item including operation and maintenance manuals in hard copy format, bound, as well as an electronic version in Adobe PDF format on a CD/DVD or removable flash drive that includes the following:

- fiber optic cable literature consisting of manufacturer specification and cut sheets,
- fiber optic equipment literature consisting of manufacturer specification and cut sheets for splice enclosures, patch panels, splice trays, jumpers, cable storage devices, and fiber optic labeling devices,
- complete factory performance data documenting conformance with the performance and testing standards referenced in this Item, including pre-installation test results of the cable system,
- installation, splicing, terminating and testing plan and procedures,
- documentation of final terminated or spliced fibers, function, and equipment designation,
- OTDR calibration certificate,
- post-installation, post termination, subsystem, and final end-to-end test results,
- loss budget calculation and documentation,
- complete parts list including names of vendors,
- complete maintenance and trouble-shooting procedures, and
- proof of minimum experience and completed projects.

4.12.1. **Installation Practice**. Submit for approval electronic copy of the Contractors Installation Practices 30 working days prior to installation. Submit installation practices and procedures and a list of installation, splicing and test equipment used. Provide detailed field quality control procedures and corrective action procedures.

4.12.2. **Manufacturer's Certification.** Accompany each reel of fiber optic cable with the manufacturer's test data showing the conformance to the requirements in this Item.

4.12.3. **Test Procedures.** Submit test procedures and data forms for the pre-installation, post-installation, subsystem, final end to end test, and loss budget calculations for approval. Test procedures will require

approval before performing tests. Submit 1 copy data forms containing data and quantitative results, as well as an authorized signature. Submit a copy of the OTDR results as a hard copy or electronic copy in PDF format including all OTDR traces and clearly identifying each event (fusion splice, jumper, connector, etc.) with the measured loss identified.

4.13. **Testing.** Perform tests in accordance with testing requirements in this Item, USDA RUS CFR 1755.900, and TIA/EIA-455-61 test specifications. For all tests, provide test forms to be used that compare measured results with threshold values.

4.13.1. **Test Methods**.

4.13.1.1. **Optical Time Domain Reflectometer (OTDR) Tests.** Use the OTDR to measure fiber optic cable for overall attenuation (signal loss dB/km), fiber cable length, and identify fiber optic cable anomalies such as breaks. Perform the following 4 OTDR tests:

- pre-Installation test (Acceptance test),
- post installation test,
- post termination test, and
- final end to end test.

OTDR Settings:

- generate a file name for each OTDR scan. The file name must indicate the location or direction the test was run from, as well as the fiber number being tested,
- set the “A” cursor at the beginning of the fiber trace and set the “B” cursor at the end of the fiber trace. The distance to cursor “B” indicates the length of the fiber cable segment being measured,
- match the index of refraction to the index of the factory report,
- set the loss indicator to dB/km for the acceptance test,
- the reflectance is automatically set internally by the OTDR,
- set the pulse width at a medium range. Change the pulse width to a slow pulse width when an anomaly occurs on the fiber trace so that it can be examined closely,
- set the average at medium speed. Change the average to slow when an anomaly appears on the fiber trace to allow for closer examination of the anomaly, and
- set wavelength at 2 windows for single mode cable: 1310 nm and 1550 nm.

Provide the current OTDR calibration certificate for the device used, showing the unit has been calibrated within the last year. Show all settings on test result fiber scans.

4.13.1.2. **Pre-installation Tests.** Test and record the fiber optic cable at the site storage area prior to installation.

Conduct bi-directional OTDR tests for each fiber strand. Test each optical fiber in the cable from one end with an OTDR compatible with wavelength and fiber type. Check testing for length, point discontinuity, and approximate attenuation. Record each measurement by color, location, and type of fiber measured. Perform a measurement from the opposite end of that fiber in case a measurement cannot be made from one end. Wait for notification if loss per kilometer exceeds manufacturer’s test data by more than 0.5 dB/km or point discontinuity greater than 0.05 dB.

Perform this test within 5 days from receipt of the fiber optic cable. Test overall attenuation (dB/km), total cable length, anomalies, and cable problems. Test cable at both wavelengths (1310 nm and 1550 nm for single mode cable). Verify that the cable markings on the outer jacket are within 1% of the total cable length.

Compare factory test results with test results and return to manufacturer if test results are not identical to factory test results. If identical, document the test results. Deliver documentation for future reference.

4.13.1.3. **Post-installation Tests.** Re-test and re-record each optical fiber in the cable after installation, before termination, for loss characteristics. Test both directions of operations of the fiber.

Immediately perform the post installation test after the fiber optic cable has been installed. Test cable for overall attenuation, cable segment length, and evidence of damage or microbend with the OTDR. Replace any cable segment that is damaged during the test and document test results. Submit test results for approval.

Use the same OTDR settings for Post-Installation Tests as the Pre-Installation Tests.

4.13.1.4. **Post Termination Tests.** Perform the post termination test after the cable is terminated or spliced, including termination of fiber cable to fiber cable or fiber cable to fiber pigtail and fiber cable to patch panels. Check attenuation, fusion or termination point problems, and overall fiber cable segment. Determine if the attenuation and quality of the termination complies with these Specifications; if not, re-terminate the fiber and re-test until the Specification requirements are met. Test the fiber segment for attenuation and anomalies after termination acceptance. Document and submit test results after fiber segment acceptance.

4.13.1.5. **Subsystem Tests.** Perform network subsystem tests after integration to the fiber optic network. Test the capability of the fiber optic cable to transmit video and digital information from node to node. A node is defined as a communication cabinet, hub cabinet, surveillance cabinet, or hub building where network hub switches are located. Complete and submit approved data forms for approval.

Correct and substitute components in the subsystem if the subsystem tests fail and repeat the tests. Components may include: cable, jumper, patch panel module, or connector.

Prepare and submit a report if a component was modified as result of the subsystem test failure. Describe in the report the failure and action taken to remedy the situation.

4.13.1.6. **Final End-to-End Test.** Perform final end to end Test after fiber cable segments of the system are terminated using the OTDR and an optical Power Meter and Light Source (PMLS).

Perform the Part 1 of the final end to end test using OTDR:

- measure the overall fiber cable system length,
- measure the overall system attenuation, and
- check for anomalies.

Perform the Part 2 of the final end to end test using a PMLS:

- measure the absolute power of the fiber optic signal across all links, and
- check for anomalies.

Document and submit results after test acceptance.

4.13.2. **Loss Budget Calculation and Documentation.** Calculate the total loss budget of the system according to the following calculations and compare the actual loss in each segment of the system to the calculated budget. Submit the results for each section of fiber optic cable in tabular format reporting if the total loss is within the limits of these Specifications by noting “pass” or “fail” for each segment of fiber. A segment of fiber is defined as one that terminates at each end. Use the following calculations to determine the loss budget for each segment:

- splice loss budget = number of splices x 0.1 dB/splice,
- connector loss budget = number of connectors x 0.75 dB/connector,
- length loss budget = length of fiber optic cable (measured by OTDR) x 0.35 dB/km for 1310 nm wavelength or 0.25 dB/km for 1550 nm wavelength, and
- total Loss Budget = splice loss budget + connector loss budget + length loss budget.

Provide loss budget calculation equations on test form to be submitted as part of the documentation requirements. Provide threshold calculations described above along with measured results.

4.14. **Training.** Conduct a BISCI or IMSA certified training class (minimum of 16 hr.) for up to 10 representatives designated by the Department on procedures of installation, operations, testing, maintenance and repair of all equipment specified within this specification. Submit to the Engineer for approval, 10 copies of the training material at least 30 days before the training begins. Conduct training within the local area unless otherwise authorized by the Engineer Include the following training material:

- NESC, NEC, and ANSI/TIA 590 code compliance,
- fiber optic cable pulling and installation techniques,
- use of installation tools,
- splicing and terminating equipment and test instruments,
- trouble shooting procedures, and
- methods of recording installation and test data.

4.15. **Warranty.** Provide a warranty for all materials furnished in this Item. Ensure that the fiber optic cable, the splice enclosures, splice centers, and cable markers have a minimum of a 2 yr. manufacturer's warranty and that 95% of that warranty remains at the date of final acceptance by the Engineer. If the manufacturer's warranties for the components are for a longer period, those longer period warranties will apply. Guarantee that the materials and equipment furnished and installed for this project performs according to the manufacturer's specifications.

Ensure that the manufacturer's warranties for off-the-shelf equipment consisting of splice enclosures, splice trays, connectors, fiber jumper cables, and fiber patch panels are fully transferable from the Contractor to the Department. Ensure that these warranties require the manufacturer to furnish replacements for any off-the-shelf part or equipment found to be defective during the warranty period at no cost to the Department within 10 calendar days of notification by the Department.

Ensure that the manufacturer's warranty for fiber optic cable is fully transferable from the Contractor to the Department. Ensure that the warranty requires the manufacturer to furnish replacement fiber optic cable found to be defective during the warranty period at no cost to the Department within 45 calendar days of notification by the Department.

5. MEASUREMENT

Fiber optic cable installed, relocated and removed will be measured by the linear foot. Fiber optic splice enclosures, rack mounted splice enclosures and fiber optic patch panels will be measured by each unit installed. Splicing of Fiber Optic Cables will be measured by each fusion splice performed.

6. PAYMENT

6.1. **Furnish and Install.**

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Fiber Optic Cable" of the various types, and number of fibers specified. This price is full compensation for furnishing and installing all cable; for pulling through conduit or duct; aerial installation; terminating; testing; and for materials, equipment, labor, tools, documentation, warranty, training and incidentals.

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Fiber Optic Splice Enclosure" of the various types and "Rack Mounted Splice Enclosure." This price is full compensation for furnishing and installing all enclosures whether aerial, underground, in cabinet or in building; and for materials, equipment, labor, tools, documentation, warranty, training and incidentals.

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Fiber Optic Fusion Splice" for each fusion splice

shown on the plans and performed. This price is full compensation for splicing; testing; and for materials, equipment, labor, tools, documentation, warranty, training and incidentals.

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Fiber Patch Panel" of the various types and sizes specified. This price is full compensation for furnishing and installing all patch panels and terminating fibers on the panel as shown on the plans; and for materials, equipment, labor, tools, documentation, warranty, training and incidentals.

Conduit will be paid for under Item 618, "Conduit" and Special Specification 6016, "ITS Multi-Duct Conduit."

Electrical conductors will be paid for under Item 620, "Electrical Conductors."

6.2. **Install Only.** The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit bid price for "Fiber Optic Cable (Install Only)" of the various types, and number of fibers specified. This price is full compensation for installing fiber optic cable furnished by the Department; for pulling through conduit or duct; aerial installation; terminating; testing; and for materials, equipment, labor, tools, documentation, warranty, training and incidentals.

Conduit will be paid for under Item 618, "Conduit" and Special Specification 6016, "ITS Multi-Duct Conduit."

Electrical conductors will be paid for under Item 620, "Electrical Conductors."

6.3. **Relocate.** The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Relocate Fiber Optic Cable." This price is full compensation for relocating all cable, regardless of cable size; for pulling through conduit or duct; aerial installation; terminating; testing; and for materials, equipment, labor, tools, documentation, and incidentals.

6.4. **Remove.** The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Remove Fiber Optic Cable". This price is full compensation for removing all cable for salvage, regardless of cable size; testing; returning to the Department; and for materials, equipment, labor, tools, documentation, and incidentals.

Special Specification 6008

Intelligent Transportation System (ITS) Ground Mounted Cabinet

1. DESCRIPTION

Furnish, fabricate, deliver, install, and test Intelligent Transportation System (ITS) ground mounted cabinets of the various types and sizes at locations shown on the plans, or as directed.

1.1. **ITS Ground Mounted Cabinet Application.** Provide ITS ground mounted cabinet to house ITS field equipment as shown on the plans, or as directed. ITS equipment applications inside the cabinet may include, but are not limited to:

- radar vehicle sensing device (RVSD),
- wireless Ethernet radio,
- closed circuit television (CCTV) field equipment,
- bluetooth reader,
- automatic vehicle identification (AVI),
- loop detection equipment,
- dynamic message sign (DMS) equipment,
- DMS controller,
- lane control signal (LCS) controller units,
- drop/insert multiplexor/demultiplexor,
- data fiber optic transceivers,
- modular fiber distribution housing,
- subrate data multiplexor distribution panel,
- ramp meter control panel,
- fiber optic video transmitter,
- fiber optic splice trays,
- CCTV color video compression system (CVCS),
- solar power assembly,
- Environmental Sensor Station (ESS),
- highway advisory radio (HAR),
- terminal servers,
- surge arrestors,
- hardened ethernet switches, and
- codecs.

Provide each cabinet complete with all internal components, back and side panels, terminal strips, harnesses, and connectors. Provide all mounting hardware necessary to provide for installation of equipment as described in this Specification. Typically, an ITS ground mounted cabinet may contain, but is not limited to the following:

- 19-in. EIA racks,
- adjustable shelves,
- fan and thermostat assemblies,
- cabinet lights,
- power distribution panel, (as required on the plans or as directed),
- right or left side panel (as required on the plans or as directed),

- surge protection,
- terminal strips,
- interconnect harnesses with connectors,
- laptop shelf and slide out drawer with telescoping drawer guides “door open” connection to back panel,
- ITS equipment hardware (as listed in Article 2.1), and
- all necessary installation and mounting hardware.

Ensure all cabinets are identical in size, shape and quality for each type as provisioned in the plans or as directed. Equip and configure the cabinet set-up as defined in this Specification and as detailed in the ITS ground mounted cabinet standards.

Submit details of the cabinet design and equipment layout for each cabinet to the Engineer for review and approval prior to fabrication.

Ensure the equipment, design, and construction use industry standard techniques with a minimum number of different parts, subassemblies, circuits, cards, and modules to maximize standardization and commonality.

Design equipment for ease of maintenance. Component parts must be readily accessible for inspection and maintenance. Tools and test instruments required for maintenance by maintenance personnel must be simple hand held tools, basic meters and oscilloscopes.

2. MATERIALS

Provide new materials that comply with the details shown on the plans, the requirements of this Item, and the pertinent requirements of the following Items:

- Item 421, “Hydraulic Cement Concrete”
- Item 440, “Reinforcing Steel”
- Item 449, “Anchor Bolts”
- Item 618, “Conduits”
- Item 620, “Electrical Conductors”
- Item 656, “Foundations for Traffic Control Devices,” and
- Item 740, “Graffiti Removal and Anti-Graffiti Coating”.

2.1. **Electrical Requirements.**

2.1.1. **Primary Input Power Interruption.** Use material that meets all the requirements in Section 2.1.4., “Power Interruption” of the National Electrical Manufacturers Association (NEMA) Standard TS2 for Traffic Control System, or most current version.

2.1.2. **Power Service Transients.** Use material that meets all the requirements in Section 2.1.6., “Transients” of the National Electrical Manufacturers Association (NEMA) Standard TS 2 for Traffic Control System, or most current version.

2.1.3. **Power Service Protection.** Ensure that equipment contains readily accessible, manually resettable or replaceable circuit protection devices (such as circuit breakers or fuses) for equipment and power source protection. Provide circuit breakers or fuses sized such that no wire, component, connector, PC board or assembly is subjected to sustained current in excess of their respective design limits upon failure of any single circuit element or wiring.

2.1.4. **Power Distribution Panel.** Provide cabinets with a 120 VAC +/- 5 VAC power distribution panel. Provide the following components on the panel:

2.1.4.1. **Duplex Receptacles.** Provide two 120 VAC NEMA Type 5-15R duplex receptacles, or as shown on the plans, protected by a circuit breaker. Permanently label duplex receptacles “For Internal ITS Equipment

Only." Install duplex receptacles in an isolated location and provide a clear 1/8 in. thick removable cover made from transparent thermoplastic material to cover the duplex receptacles. Ensure this cover is installed as not to interfere with the functional operation within the cabinet and allows enough space to plug in AC adapters and any necessary equipment. Submit alternative cover material for approval as part of the documentation submittal requirement.

2.1.4.2. **Ground Fault Circuit Interrupter (GFCI) Duplex Receptacles.** Provide at least one 120 VAC NEMA Type 5-15R GFCI duplex receptacle, or as shown on the plans, protected by a circuit breaker. This GFCI duplex receptacle is intended for maintenance personnel and is not to be used to serve equipment inside the cabinet. Permanently label GFCI duplex receptacles "For Personnel Use." Install GFCI duplex receptacles in a readily accessible location.

Provide a 120 VAC, rack mountable outlet strip with 6 NEMA Type 5-15R receptacles with surge suppression. Plug outlet strip into GFCI duplex receptacle and label for personnel use.

Circuit Breakers. Determine the ampere rating, quantity, and configuration for main, accessory, spare, and equipment circuit breakers to support ITS equipment loads as shown on the plans. Provide Underwriters Laboratories (UL) 489 listed circuit breakers capable of operating in accordance with Section 2, "Environmental Standards and Test Procedures" of NEMA TS2-2003, or most current version. Provide circuit breakers with an interrupt capacity of 5,000 A. and insulation resistance of 100 megohms at 500 VDC. Provide minimum ampere rating for the following circuit types:

2.1.4.2.1. **Main Breaker.** Size the main circuit breaker such that the load of all branch circuits is less than the main circuit breaker ampere rating in accordance with the most current version of the National Electrical Code (NEC).

2.1.4.2.2. **Accessory Breaker.** Minimum 15 A. Size accessory circuit breaker to protect lighting, door switches, fans, and GFCI duplex receptacle in accordance with the most current version of the NEC.

2.1.4.2.3. **Equipment Breakers.** Minimum 15 A. Size equipment breaker to protect ITS equipment and duplex receptacles in accordance with the most current version of the NEC.

2.1.4.2.4. **Spare Equipment Breaker.** Minimum 20 A. Provide one spare equipment breaker for future use.

Furnish breakers, which are in addition to any auxiliary fuses, with the electronic equipment to protect component parts. Provide 3-terminal lightning arrestor to protect the load side of all circuit breakers. Connect the arrestor into the circuit with size 8 AWG or larger stranded copper conductors. Connect arrestor to the line filter as recommended by the manufacturer.

2.1.4.3. **Power Line Surge Protection.** Provide and install power line surge protection devices that meet the requirements of Article 2.4.1.

2.1.4.4. **Power Cable Input Junction Terminals.** Provide power distribution blocks suitable for use as a power feed and junction points for 2 and 3 wire circuits. Accommodate up to No. 4 AWG conductors on the line side of each circuit. Provide appropriate sized lugs at the junction terminals for conductors larger than a No. 4 AWG when shown on the plans.

Electrically isolate the AC neutral and equipment ground wiring from the line wiring by an insulation resistance of at least 10 megohms when measured at the AC neutral. Color code the AC neutral and equipment grounding wiring white and green respectively in accordance with the most current version of the NEC.

Utilize the back panel to distribute and properly interconnect all cabinet wiring related to the specific complement of equipment called out on the plans. Each item of equipment including any furnished by the Department must have the cable harness properly terminated at terminal boards on the back panel. Ensure all functions available at the equipment connector are carried in the connector cable harness to the terminal blocks from the power distribution panel mounted on the left side panel of the cabinet.

2.1.5. **Right Side Panel.** When shown on the plans, for a required ITS application, provide fully wired loop input distribution panel to be mounted on the lower right inside wall when facing the front inside of the door opening of the cabinet. Provide a detailed layout for approval by the Engineer. Provide a panel with the following:

2.1.5.1. **Power Distribution.** If any 115 VAC power is needed on the right side panel, it will be obtained from the power distribution terminal board located on the left side panel, which is fed from the equipment circuit breaker located on the left side panel.

2.1.5.2. **Loop Surge Protection.** Mount surge protection for incoming loop pairs on the right side panel.

2.1.6. **Back Panel.** When shown on the plans, for a required ITS application, provide cabinet with a fully wired equipment panel to be mounted on the lower rear inside wall of the cabinet. Provide a detailed layout for approval by the Engineer. Panel to include detector terminal boards to accommodate equipment shown on the plans or as directed.

2.1.7. **Alternative Power Option.** When shown on the plans, accommodate renewable electrical power source for the design load specified in accordance with "ITS Solar Power System" Specification. Renewable electrical power source may, or may not, be integrated with public utility electrical services, as shown on the plans or as directed. Accommodate solar system components including batteries and solar charge controller.

2.1.8. **Wiring.** Ensure all cabinet wiring identified by the use of insulated pre-printed sleeving slipped over the wire before attachment of the lug or making the connection. Supply enough text on wire markers in plain words or abbreviations with sufficient level of detail so that a translating sheet will not be required to identify the type and size of wire.

Cut all wires to the proper length before assembly. Ensure no wires are doubled back to take up slack. Ensure harnesses to connectors are covered with braided cable sleeves. Secure cables with nylon cable clamps.

Provide service loops to facilitate removal and replacement of assemblies, panels, and modules. Use insulated parts and wire rated for at least 600 V. Color-code harnesses and wiring.

Route and bundle all wiring containing line voltage AC separately or shield from all low voltage, i.e., control circuits. Cover all conductors and live terminals or parts, which could be hazardous to maintenance personnel, with suitable insulating material.

Provide AC internal cabinet wiring identified in accordance with the most current version of the NEC. Provide white insulated conductors for AC common. Provide green insulated conductors for equipment ground. Provide any color different from the foregoing on other conductors in accordance with the most current version of the NEC. For equipment that requires grounding, provide ground conductors and do not use conduit for grounding. Provide No. 22 AWG or larger stranded conductors for internal cabinet wiring. Provide conductors that are UL-listed THHN in accordance with the most current version of the NEC. Ensure the insulation has at least a thickness of 10 mm. Ensure all wiring containing line voltage is at least size No. 14 AWG. No strands of any conductor may be trimmed to "fit" the wiring into the breaker or terminal block.

2.1.9. **Terminal Strips.** Provide terminal strips located on the back panel that are accessible to the extent that it is not necessary to remove the electronic equipment from the cabinet to make an inspection or connection.

Ensure terminal blocks are 2 position, multiple pole barrier type.

Provide shorting bars in each of the positions provided, along with an integral marking strip.

Arrange terminal blocks such that they will not upset the entrance, training and connection of incoming field conductors.

Identify all terminals with legends permanently affixed and attached to the terminal blocks.

Ensure not more than 3 conductors are brought to any 1 terminal screw.

Ensure no electrically energized components or connectors extend beyond the protection afforded by the barriers.

Locate all terminal blocks below the shelves.

Ensure terminals used for field connections are secure conductors by means of a No. 10-32 nickel or cadmium plated brass binder head screw.

Ensure terminals used for interwiring connections, but not for field connections, are secure conductors by means of a No. 5-32 nickel plated brass binder head screw.

Terminate all connections to and from the electronic equipment to an interwiring- type block. These blocks will act as intermediate connection points for all electronic equipment input and output.

Provide termination panels that are used to distribute and properly interconnect all cabinet wiring related to the specific complement of equipment as shown on the plans. Provide properly terminated cable harnesses for each item, including any furnished by the Department. Provide all functions available at the equipment terminals that are carried in the connector cable harness.

2.1.10. **Cabinet Internal Grounding.** The cabinet internal ground consists of at least 1 ground bus-bar permanently affixed to the cabinet and connected to the grounding electrode.

Use bare stranded No. 4 AWG copper wire between bus-bars and between the bus-bar and grounding electrode.

Ensure each copper ground bus-bar has at least 14 connection points, each capable of securing bare conductor ranging in size from No 4 AWG to No 14 AWG.

Return AC neutral and equipment ground wiring to these bus-bars.

2.1.11. **Door Switch.** Provide a door switch meeting the following requirements:

- momentary, pin-type door switch,
- installed in the cabinet or on the door,
- connected to a terminal so that the equipment installed in the cabinet can confirm input is connected to logic ground when the cabinet door is open, and
- engage cabinet light when the door is opened.

Provide 2 momentary, pin-type door switches for each door provided with the cabinet. Wire 1 switch to turn on the cabinet lights when the door is open, and off when the door is closed. Wire the other in parallel to a terminal block to detect a cabinet intrusion condition.

2.2. **Mechanical Requirements.**

2.2.1. **Size and Construction.** Provide ITS ground mounted cabinets meeting the configuration types detailed in the ITS Ground Mounted Cabinet standards.

Table 1
Minimum Cabinet Dimensions

	Depth (in.)	Width (in.)	Height (in.)
Type 4	**30**	**24**	**66**
Type 5	**26**	**44**	**54**
Type 6	**26**	**44**	**66**

Determine the suitability of the listed cabinet configuration types for the equipment at each field location identified on the plans or as directed.

2.2.2. **Ventilation.** Provide the cabinet with vent openings to allow cooling of electronic components.

Locate louvered air intake vent openings on the lower portion of the cabinet doors and cover fully inside with a commercially available disposable 3 layer graded pleated type filter with a minimum size of 16 in. (high) x 16 in. (wide) and a thickness of 1 in. For Type 5 cabinet, provide 2 filters for each door. Securely mount so that any air entering the cabinet must pass through the filter. Ensure the cabinet opening for intake of air is large enough to accommodate filter size. Screen the exhaust to prevent entry of insects. Provide the screen openings no larger than 0.0125-sq. in.

Vent and cool the cabinet by thermostatically controlled electric fans. Provide adjustable thermostat with an adjustment range of 70 to 110°F. Provide a press-to-test switch to test the operation of the fan.

Provide at least 4 commercially available fans with a capacity of at least 110 cfm each. Provide the total free air opening of the vent large enough to prevent excessive back-pressure on the fan.

2.2.3. **Lighting.** Provide minimum 15 W fluorescent light fixtures above each door inside the cabinet, each with clear shatter proof lens. NEMA TS2 rated light-emitting diode (LED) fixtures are acceptable instead of fluorescent light fixtures. Determine the appropriate number of fixtures to achieve at least 1000 lumens to illuminate the equipment. Position the fixtures to provide illumination to the face of the equipment in the cabinet and not into a technician's eyes.

2.2.4. **Exterior Finish.** Provide cabinets with a smooth aluminum finish and the exterior in its unpainted natural color.

When shown on the plans or as directed, provide cabinets with an anti-graffiti coating in accordance with Item 740 “Graffiti Removal and Anti-Graffiti Coating.”

2.2.5. **Serial Number.** Provide the cabinets with a serial number unique to the manufacturer, preceded by an assigned 2 letter manufacturer's code. Provide at least a 0.2 in. letter height. Stamp the entire identification code and number on a metal plate riveted to the cabinet, stamp directly on the interior cabinet wall, or engrave on a metalized mylar plate that is epoxied to the cabinet on the upper right hand cabinet side wall.

2.2.6. **Modular Design.** Provide cabinets that have a modular design and allow ITS equipment to be installed in a variety of mounting configurations as detailed on the plans or as directed.

Provide Type 4 cabinets with 1 Electronic Industries Alliance (EIA) 19 in. rack cage, sized appropriately based on cabinet type inside height dimension. Provide a rack with at least 1 1RU (RU = rack unit) horizontal power strip. Provide 2 unistrut or DIN rail channels on each side wall of the cabinet for mounting power panel and auxiliary ITS equipment.

Provide Type 5 and Type 6 cabinets with 2 side by side EIA 19 in. racks, sized appropriately based on cabinet type inside height dimension. Provide a rack with at least of 1 1RU horizontal power strip. Provide 2 unistrut or DIN rail channels on each side wall of the cabinet for mounting power panel and auxiliary ITS equipment.

2.2.7. **Shelves.** Provide adjustable shelves in each cabinet as required to support the equipment as specified on the plans. Ensure shelf adjustment is at 1 RU intervals in the vertical position. Provide shelves that can be mounted to an EIA 19 in. rack cage or unistrut channel as detailed in the standards.

Provide shelves that are removable and capable of supporting the electronic equipment. Provide a minimum of 2 in. between the back and front edge of the shelf to back inside wall and door of the cabinet respectively to allow room for the equipment cables and connectors.

Provide each cabinet type with at least 1 slide out drawer with telescoping drawer guides to allow full extension from the rack frame. Provide at least 1.75 in. (high) x 16 in. (wide) x 14 in. (deep) drawer with a hinged lid to allow access to storage space.

2.3. **Surge Protective Devices (SPD).** Provide SPDs to protect electronics from lightning, transient voltage surges, and induced current. Install SPDs on all power, data, video, and any other conductive circuit.

2.3.1. **120 V or 120/240 V SPD at Service and ITS Cabinet Power Distribution Panel.** Install an SPD at the closest termination or disconnection point where the supply circuit enters the cabinet. Locate the SPD on the load side of the cabinet power distribution panel breakers and ahead of any and all electronic devices. Keep leads as short as possible with all conductor bends formed to the maximum possible radius. Connect the SPD ground lead directly to the ground bus. Use of wire nuts is prohibited. Install in accordance with manufacturers recommendations.

Provide UL Listed Type 1 or Type 2 SPD and labeled to UL1449 Third Edition, posted at UL.com, under Certifications UL Category Code VZCA, and have a 20kA I-nominal rating. Provide SPD rated as NEMA 4. SPD with integral EMI/RFI line filtering may be required if shown on the plans.

Do not exceed 700 V on the Voltage Protection Rating (VPR) on any mode (L-N, L-G, and N-G).

Do not exceed 150 V on the Maximum Continuous Operating Voltage (MCOV).

Equal or exceed 40kA the SPD surge current rating per mode (L-N), (L-G), (N-G).

Equal or exceed 50 kA or the available short circuit current, whichever is higher for the SPD Short Circuit Current Rating (SCCR).

Provide SPD with directly connected Metal Oxide Varistors (MOV) exceeding 32 mm in diameter with thermal safety disconnectors. Gas tube and spark gap SPD are not be permitted. Ensure each MOV's operational status can be monitored via visual indicator, including N-G mode.

Provide SPD with one set of Normally Open (NO), Normally Closed (NC) Form C contacts for remote monitoring.

Ensure the SPD utilized for AC power does not dissipate any energy and does not provide any series impedance during standby operation. Return the unit to its non-shunting mode after the passage of any surge and do not allow the shunting of AC power.

2.3.2. **Parallel SPD for 120 V Equipment.** Install an SPD inside of the cabinet on the power distribution to the equipment. Keep leads as short as possible with all conductor bends formed to the maximum possible radius. Connect the SPD ground lead directly to the ground bus. Use of wire nuts is prohibited. Install in accordance with manufacturers recommendations.

Provide UL Listed Type 1 or Type 2 SPD labeled to UL1449 Third Edition, posted at UL.com, under Certifications UL Category Code VZCA, and have a 20kA I-nominal rating. Provide SPD rated as NEMA 4.

Do not exceed 700 V on the Voltage Protection Rating (VPR) on any mode (L-N and N-G).

Do not exceed 150 V on the Maximum Continuous Operating Voltage (MCOV).

Equal or exceed 40 kA the SPD surge current rating per mode (L-N) and (N-G).

Equal or exceed 50 kA or the available short circuit current, whichever is higher for the SPD Short Circuit Current Rating (SCCR).

Provide SPD with directly connected Metal Oxide Varistors (MOV) exceeding 32 mm in diameter with thermal safety disconnectors. Gas tube and spark gap SPD are not be permitted. Ensure each MOV's operational status can be monitored via visual indicator, including N-G mode.

Provide SPD with one set of Normally Open (NO), Normally Closed (NC) Form C contacts for remote monitoring.

2.3.3. **Low-Voltage Power, Control, Data and Signal Systems SPD.** Install a specialized SPD on all conductive circuits including, but not limited to, data communication cables, coaxial video cables, and low-voltage power cables. Ensure that these devices comply with the functional requirements shown in Table 2 for all available modes (i.e., power L-N, N-G; data and signal center pin-to-shield, L-L, L-G, and shield-G where appropriate).

These specialized SPD must have an operating voltage matching the characteristics of the circuit. Ensure that these specialized SPD are UL 497B or UL 497C Listed, as applicable.

Provide the SPD with 3 stages of surge suppression in a Pi (π) configuration. The first stage (primary side) consists of parallel-connected Gas Discharge Tubes (GDTs). The second stage consists of a series connected resistor or inductor. The third stage (secondary side) consists of parallel-connected transorbs or silicone avalanche diodes (SADs).

Ground the SPD to the DIN rail and a wire terminal connection point. (Grounding solely through the DIN rail connection is not adequate and does not meet the performance or intent of this specification.)

Install coaxial SPDs in a manner that prevents ground loops and resulting signal deterioration. This is usually caused where the cable has different references to ground at either end and connecting SPDs at both ends that have only Pin to Shield protection completes a ground loop circuit through the Shield. SPDs having Pin to Shield protection, and separate Shield to Ground protection are acceptable to eliminate ground loops.

Table 2
SPD Minimum Requirements

Circuit Description	Maximum Continuous Operating Voltage (MCOV)	Frequency/ Bandwidth/ Data Rate	Surge Capacity	Maximum Let-Through Voltage
12 VDC	15-20 V	N/A	5 kA per mode (8x20 µs)	<150 Vpk
24 VAC	30-55 V	N/A	5 kA per mode (8x20 µs)	<175 Vpk
48 VDC	60-85 V	N/A	5 kA per mode (8x20 µs)	<200 Vpk
Coaxial Composite Video	4-8 V	Up to 1.5 GHz	10 kA per mode (8x20 µs)	<100 Vpk
RS422/RS485	8-15 V	Up to 10 Mbps	10 kA per mode (8x20 µs)	<30 Vpk
T1	13-30V	Up to 10 Mbps	10 kA per mode (8x20 µs)	<30 Vpk
Ethernet Data	7-12V	Up to 100 Mbps	3 kA per mode (10x1000 µs)	<30 Vpk

2.4. **Environmental Design Requirements.** Provide cabinets that meet the functional requirements of this Item during and after subjection to any combination of the following requirements:

- ambient temperature range of -30 to 165°F,
- temperature shock at most 30°F per hour, during which the relative humidity does not exceed 95%,
- relative humidity range at most 95% over the temperature range of 40 to 110°F, and
- operates with moisture condensation on all surfaces caused by temperature changes.

2.5. **Vibration.** Material used must show no degradation of mechanical structure, soldered components, plug in components or satisfactory operation in accordance with the manufacturer's equipment specifications after being subjected to the vibration test as described in the NEMA standard TS2, Section 2.2.8, “Vibration Test”, or the most current version.

3. FABRICATION

3.1. **Ground Mounted Cabinet.** Continuously weld all exterior seams for cabinet and doors. Fill edges to a radius of 0.03125 in. minimum. Smooth exterior welds.

Welding on aluminum cabinets are done by the gas metal arc (MIG) or gas tungsten arc (TIG) process using bare aluminum welding electrodes. Ensure electrodes conform to the requirements of the American Welding Society (AWS) A5.10 for ER5356 aluminum alloy bare welding electrodes.

Procedures, welding machines and welding machine operators for welding on aluminum must be qualified and conform with the requirements of AWS B3.0, “Welding Procedures and Performance Qualification”, and to the practices recommended in AWS C5.6.

Construct all cabinets of welded sheet aluminum with a thickness of at least 0.125 in. meeting NEMA 3R standards. Do not allow wood, wood fiber product, or flammable products in the cabinet. Seal cabinet structure to prevent the entry of rain, dust, and dirt.

Provide a sunshield on the exterior top of the cabinet to reflect solar rays and mitigate temperature build-up inside the cabinet. Construct sunshield out of 0.125 in. thick aluminum and provide a minimum of 1.25 in. clearance above the top of cabinet secured in four locations.

Attach aluminum lifting eyes or ears to the top of the cabinet to permit lifting the cabinet with a sling. Lifting eyes may be permanently fabricated to the cabinet frame as long as they do not interfere with the construction and operation of the sunshield. Manufacturer may provide removable lifting eyes that can be removed after installation. Seal any penetrations to the cabinet exterior or sunshield after removal of lifting eyes.

Ensure cabinets conform to the requirements of ASTM designation: B209 for 5052-H32 aluminum sheet.

3.1.1. **Door.** Provide sturdy and torsionally rigid cabinet doors that overlap and substantially cover the full area of the front of the cabinet. Attach cabinet doors by a minimum of 3 heavy duty hinges or full length hinge. Provide stainless steel hinge pins.

Fabricate the doors and hinges to withstand a 100 lb. per vertical foot force applied to the outer edge of the door when open without permanent deformation or impairment of the door or cabinet body when the load is removed.

Fit the cabinet doors with Number 2 Corbin lock and aluminum or chrome plated handle with at least a 3/8 in. drive pin and a 3 point latch. Design the lock and latch so that the handle cannot be released until the lock is released. Provide a padlock of the type directed by the Engineer. Provide a locking ring for a padlock. Provide 2 keys for the door and 2 keys for the padlock with each cabinet. Locate the lock clear of the arc of the handle. Keys must be removable in the locked position only. Mount locks with 2 stainless steel machine screws. Provide cabinet doors with a catch mechanism to hold the door open at 3 positions: 90°, 120°, and 160°.

Fabricate the door and door stop mechanism to withstand a simulated wind load of 5 lb. per sq. ft. applied to both inside and outside surfaces without failure, permanent deformation, or compromising of door position.

Provide cabinets without auxiliary police doors.

Provide a gasket to act as a permanent and weather resistant seal at the cabinet door facing. The gasket material must be of a non-absorbent material and maintain its resiliency after long term exposure to the outdoor environment.

Provide a gasket with a minimum thickness of 0.25 in. Locate the gasket in a channel provided for this purpose either on the cabinet or on the door. An “L” bracket is acceptable instead of this channel if the gasket is fitted snugly against the bracket to insure a uniformly dust and weather resistant seal around the entire door facing.

3.1.2. **Mechanical Components.** Ensure all external screws, nuts, and locking washers are stainless steel. Do not use self-tapping screws unless specifically approved by the Engineer.

Ensure all parts are made of corrosion resistant material, such as plastic, stainless steel, aluminum or brass.

Ensure all materials used in construction are resistant to fungus growth and moisture deterioration.

Separate dissimilar metals by an inert dielectric material.

4. CONSTRUCTION

4.1. **General**. For ITS cabinets installed on a slope, ensure the cabinet primary door faces and opens to the high side of the slope and provide safety railing in accordance with the ITS ground mounted cabinet standards. Safety railing is subsidiary to this Item. Stake cabinet foundation forms and underground conduit entering the foundation before installation and secure Department approval before pouring foundation. It is understood that cabinet location may vary from the plans to accommodate field conditions.

Construct the cabinet foundation in accordance with Item 656, “Foundations for Traffic Control Devices”, unless otherwise specified by the Engineer.

Concrete maintenance pads have been integrated into the foundation design found on the ITS ground mounted cabinet standards to accommodate door configuration options.

4.2. **Mounting Hardware.** Furnish anchor bolts to mount the cabinet to the foundation. Manufacturer to determine the appropriate size anchor bolts by cabinet type and foundation size. Provide appropriate mounting plates and any other necessary hardware to mount the cabinet on a foundation.

4.3. **Installation.** Ground the cabinet as depicted in the ITS grounding standards. For retrofit scenarios, measure resistance to ground before installing cabinet in accordance with IEEE 81. Provide additional grounding rods and install additional grounding conductors as detailed in the ITS Grounding Standards to achieve less than 5 ohms resistance. Additional ground rods and grounding conductors are subsidiary to this Item.

Immediately before mounting the cabinet on the foundation, apply a bead of silicone caulk to seal the cabinet base to the foundation.

Seal any space between conduit entering the cabinet and the foundation with silicone caulk or approved sealant compound.

Install conduits as shown on the plans or as directed and in accordance with Item 618, “Conduit.” Place wiring in a neat and orderly manner grouped together with nylon tie-downs.

After wiring is installed, seal the conduits terminated in the cabinet foundation with a duct seal or other similar approved sealant inside of the ends of the conduit in the cabinet to prevent moisture, insects and critters from entering the conduits.

4.3.1. **Connection of Lead-In Cable.** Connect the detector lead-in cables, when shown on the plans or as directed, to the detector terminal blocks in the following manner:

Dress each cable into position in conformance with the approved lead-in cable position on the panel (bundle cables together and broken out by their position on the terminal boards),

Place cable as close to the terminal points as possible and left floating, and

Ground the cable shield after testing and in accordance with the detector manufacturers' specifications.

4.3.2. **Connection of Miscellaneous Cables.** Terminate connection of signal wires, sign control wires and any other wires required to complete connections for an operational system on terminal blocks.

Design the equipment for ease of maintenance. All component parts must be readily accessible for inspection and maintenance. The only tools and test instruments required for maintenance by maintenance personnel must be simple hand held tools, basic meters and oscilloscopes.

Mount cabinet plumb in all directions.

4.4. **Removal and Replacement of Curbs and Walks.** The Contractor to secure approval of the Engineer before cutting into or removing sidewalks or curbs not shown on the plans to be removed or replaced.

Restore any curbs or sidewalks after work is completed, which have been removed, to equivalent original condition and to the satisfaction of the Engineer.

All completed surfaces that are adjacent to the cabinet foundation must be level and free of trip hazards. Any difference in level of adjacent structures are to be addressed in the field and approved by the department.

4.5. **Relocation.** Before removal of the existing cabinet, disconnect and isolate the power cables from the electric power supply and disconnect all cables (power and communication) from the equipment.

Inspect the existing cabinet, with a representative from the Department, and document any evidence of structural damage before removal. Remove and deliver to the Department existing cabinets that fail structural inspection to an address to be supplied by the Department.

Remove the existing cabinet in a manner acceptable to the Engineer. Use a method that does not cause undue overstress or damage to the structure or appurtenances attached.

Remove the existing concrete foundation to a depth of at least 2 ft. below finish grade with all steel cut off. Backfill the excavation with material equal in composition and density to the surrounding area. Replace any surfacing, such as asphalt pavement, concrete riprap or brick pavers, with like material to equivalent condition as approved by the Engineer.

Supply all new anchor bolts required for the installation of the cabinet. Match bolt dimensions and lengths previously used or as shown on the plans or as directed.

4.6. **Removal.** Present the work in a neat, professional finished appearance. Maintain safe construction and operation practices. Use established industry and utility safety practices when removing cabinets near overhead or underground facilities. Consult with the appropriate utility company before beginning work.

Inspect the cabinet, with a representative from the Department, and remove any ITS equipment, associated mounting hardware, and cabling inside the cabinet before commencing work.

Before removal of the existing cabinet, disconnect and isolate the power cables from the electric power supply and disconnect all cables (power and communication) from the equipment. Remove and coil existing cabling to the nearest ITS ground box or as identified on the plans.

Carefully remove the cabinet and avoid damage or injury to surrounding objects or individuals. Deliver the cabinet to an address to be supplied by the Department.

Remove the existing foundation to a depth of 2 ft. below grade with all steel cut off. Backfill the excavation with material equal in composition and density to the surrounding area. Replace any surfacing, such as asphalt pavement, concrete riprap, or brick pavers, with like material to equivalent condition as approved by the Engineer.

4.7. **Testing.**

4.7.1. **Installation**. Unless otherwise shown on the plans, perform the following tests on cabinets supplied through this Item.

4.7.1.1. **Test Procedures Documentation**. Provide 5 copies of the test procedures to include tests identified in Article 4.9.2 through Article 4.9.4 inclusive and blank data forms to the Engineer for review and comment at least 45 days before testing for each test required on this project. Include the sequence of the tests in the procedures. The Engineer will comment, approve, or reject test procedures within 30 days after Contractor submittal of equipment for tests. Contractor to resubmit if necessary rejected test procedures for final

approval within 10 days before testing. Review time is calendar days. Conduct all tests in accordance with the approved test procedures. The Department may witness all tests.

Record test data and quantitative results on data forms. No bid item measurement or payment will be made until the Engineer has verified the test results meet the requirements of the specification. The data forms for all tests, except design approval tests, must be signed by an authorized representative of the Contractor.

Provide written notice to the Engineer within 48 hr. of discovery of any testing discrepancy performed in testing by the contractor. Furnish data forms containing the acceptable range of expected results and measured values.

4.7.1.2. **Design Approval Test**. Conduct a design approval test on 10 percent of the total number of cabinets supplied as part of the project, with at least 1 of each type of cabinet used on the project.

Certification from an independent testing laboratory of a successfully completed design approval test is acceptable. Ensure that the testing by this laboratory is performed in accordance with the requirements of this specification. Failure of independent tests to comply with the requirements of this specification will be grounds for rejection of any certification.

Provide a copy of the certification to the Engineer. The data forms for the design approval tests must be signed by an authorized representative (company official) of the equipment manufacturer or by an authorized representative of an independent testing facility.

Notify the Engineer 10 working days before conducting this testing. The Department may witness all the tests. Perform the following tests:

4.7.1.2.1. **Power Service Transients.** Provide equipment that meets the performance requirements, specified in this Item, when subjected to the power service transients as specified in NEMA TS 2, Section 2.2.7.2, “Transient Tests (Power Service)”, or most current version.

4.7.1.2.2. **Temperature and Condensation.** Provide equipment that meets the performance requirements, specified in this Item, when subjected to the following conditions in the order specified below:

- Stabilize the equipment at -30°F and test as specified in NEMA TS2, Sections 2.2.7.3, “Low-Temperature Low-Voltage Tests” and 2.2.7.4, “Low-Temperature High-Voltage Tests”, or most current version.
- Allow the equipment to warm up to room temperature in an atmosphere with relative humidity of at least 40%. Operate the equipment for 2 hr., while wet, without degradation or failure.
- Stabilize the equipment at 165°F and test as specified in NEMA TS2, Sections 2.2.7.5, “High-Temperature High Voltage Tests” and 2.2.7.6, “High-Temperature Low-Voltage Tests”, or most current version.

4.7.1.2.3. **Relative Humidity.** Provide equipment that meets the performance requirements, specified in this Item, within 30 min. of being subjected to a temperature of 165°F and a relative humidity of 18% for 48 hr.

4.7.1.2.4. **Vibration.** Provide equipment that shows no degradation of mechanical structure, soldered components, or plug-in components and will operate in accordance with the manufacturer's equipment specifications after being subjected to the vibration tests as described in NEMA TS2, Section 2.2.8, “Vibration Test”, or most current version.

4.7.1.2.5. **Power Interruption.** Provide equipment that meets the performance requirements, specified in this Item, when subjected to nominal input voltage variations as specified in NEMA TS2, Section 2.2.10, “Power Interruption Test”, or most current version.

4.7.1.3. **Stand-Alone Tests**. Conduct a stand-alone test for each cabinet after installation. Exercise all stand-alone (non-network) functional operations consisting of the following, at a minimum:

- 19-in. EIA rack,
- adjustable shelves,
- locking mechanism,
- fan and thermostat,
- cabinet light,
- back panel,
- circuit breakers,
- surge protection,
- grounding system,
- terminal strips,
- interconnect harnesses with connectors,
- weatherproofing, and
- "Door Open" connection to back panel.

Notify the Engineer 5 working days before conducting this test. The Engineer may witness all the tests.

4.7.1.4. **Consequences of Test Failure**. If a unit fails a test, submit a report describing the nature of the failure and the actions taken to remedy the situation before modification or replacement of the unit. If a unit requires modification, correct the fault and then repeat the test until successfully completed. Correct minor discrepancies within 30 days of written notice to the Engineer. If a unit requires replacement, provide a new unit and then repeat the test until successfully completed. Major discrepancies that will substantially delay receipt and acceptance of the unit will be cause for rejection of the unit.

Failure to satisfy the requirements of any test is considered a defect and the equipment is subject to rejection by the Engineer. The rejected equipment may be offered again for retest provided all noncompliance has been corrected.

If a failure pattern develops in similar units within the system, implement corrective measures, including modification or replacement of units, to all similar units within the system as directed. Perform the corrective measures within 30 calendar days without additional cost or extension of the contract period.

4.7.1.4.1. **Consequences of Design Approval Test Failure.** If the equipment fails the design approval test, correct the fault within 30 days and then repeat the design approval test until successfully completed.

4.7.1.4.2. **Consequences of Demonstration Test Failure.** If the equipment fails the demonstration test, correct the fault within 30 days and then repeat the demonstration test until successfully completed.

4.7.1.4.3. **Consequences of Stand-Alone Test Failure.** If the equipment fails the stand-alone test, correct the fault and then repeat the stand-alone test until successfully completed.

4.7.2. **Relocation.**

4.7.2.1. **Pre-Test.** Conduct performance testing before removal of ITS ground mounted cabinets. Test all functional operations of the equipment, at a minimum, and document functional operations in the presence of representatives of the Contractor and the Department.

- locking mechanism,
- fan and thermostat,
- cabinet light,
- back panel,
- circuit breakers,
- surge protection system,
- grounding system, and

- "Door Open" connection to back panel.

Ensure that both representatives sign the test report indicating that the equipment has passed or failed each function. Once removed, the equipment becomes the responsibility of the Contractor until accepted by the Department. Compare test data before removal and test data after installation.

4.7.2.2. **Post Test**. Testing of the ITS ground mounted cabinet is for the purpose of relieving the Contractor of maintenance of the system. The Contractor will be relieved of the responsibility for maintenance of the system in accordance with Item 7, "Legal Relations and Responsibilities", after a successful test period. The Contractor will not be required to pay for electrical energy consumed by the system.

After all existing ITS equipment has been installed, perform the same functional operation test described under Article 4.9.2.1. Furnish test data forms containing the sequence of tests including all of the data taken and quantitative results for all tests. Submit the test data forms to the Engineer at least 30 days before the day the tests are to begin. Obtain Engineer's approval of test procedures before submission of equipment for tests. Send at least 2 copies of the data forms to the Engineer.

The performance test results after relocation must be equal to or better than the test results before removal. Contractor is responsible to repair or replace those components within the system which failed after relocation but which passed before removal.

The Department will conduct approved ITS equipment system tests on the field equipment hardware with the central equipment. The tests will exercise all remote control functions and display the return status codes from the controller.

If any unit fails to pass a test, prepare a report and deliver it to the Engineer. Describe in the report the nature of the failure and the corrective action needed. If the failure is the result of improper installation or damage during reinstallation, reinstall or replace the unit and repeat the test until the unit passes successfully, at no additional cost to the Department or extension of the Contract period.

4.8. **Documentation.** Submit documentation for this Item consisting of the following:

4.8.1. **Ground Mounted Cabinet.** Shop drawings should clearly detail the following for ITS ground mounted cabinets when required as shown on the plans:

- dimensions,
- shelves,
- door,
- gasket,
- door look,
- materials list,
- exterior finish,
- ventilation,
- terminal strips,
- harnesses,
- filter,
- power distribution panel,
- surge suppression,
- back panel,
- outlets,
- circuit breakers,
- power cable terminals,
- wiring diagrams,
- cabinet grounding,
- environmental parameters, and
- connectors.

Submit shop drawings, signed, sealed, and dated by a registered professional Engineer in Texas showing the fabrication, interior configuration, electrical distribution, and cabinet mounting details for each cabinet in accordance with Item 5, "Control of the Work."

Provide at least 2 complete sets of operation and maintenance manuals in hard copy format in addition to a CD/DVD or removable flash drive that includes the following:

- complete and accurate schematic diagrams,
- complete installation procedures,
- complete performance specifications (functional, electrical, mechanical and environmental) on the unit,
- complete parts list including names of vendors for parts not identified by universal part number such as JEDEC, RETMA, or EIA,
- pictorial of component layout on circuit board,
- complete maintenance and trouble-shooting procedures,
- complete stage-by-stage explanation of circuit theory and operation,
- recovery procedures for malfunction, and
- instructions for gathering maintenance assistance from manufacturer.

Identify material which is copyrighted or proprietary in nature as part of the documentation submittal. The Department will take proper provisions to secure such material and not distribute without written approval.

Provide the Department with certification documentation verifying conformance with environmental and testing requirements contained in the special specification. Certifications may be provided by the manufacturer or through independent labs.

4.9. **Warranty.** The start date of the manufacturer's standard warranty will begin when the stand-alone test plan has been approved. Any equipment with less than 95% of its warranty remaining at the beginning of the stand-alone test will not be accepted by the Department. Guarantee that equipment furnished and installed for this project performs according to the manufacturer's published specifications. Warrant the equipment against defects or failure in design, materials, and workmanship for a minimum of 5 years or in accordance with the manufacturer's standard warranty if warranty period is greater. Assign, to the Department, all manufacturer's normal warranties or guarantees on all electronic, electrical, and mechanical equipment, materials, technical data, and products furnished for and installed on the project. Repair or replace, at the manufacturer's option, defective equipment during the warranty period at no cost to the Department.

Repair or replace equipment at the Contractor's expense before beginning testing in the event of a malfunction or failure. Furnish replacement parts for all equipment within 30 days of notification of failure by the Department.

5. MEASUREMENT

This Item is measured as each unit furnished, installed, relocated, or removed as shown on the plans or as directed, excluding new conduit.

6. PAYMENT

6.1. **Furnish and Install.** The work performed and materials furnished in accordance with this Item and measured as provided for under "Measurement" will be paid for at the unit price bid for "ITS Ground Mount Cabinet" of the type and configuration specified. This price is full compensation for furnishing, fabricating, and installing ITS ground mounted cabinets as shown on the plans; for forming and setting the cabinet foundation; for furnishing and placing anchor bolts, nuts, and washers; for furnishing and placing electrical conduit in the foundation; for appropriately grounding the cabinet; and equipment, materials, labor, tools, and incidentals necessary to provide an ITS ground mounted cabinet, complete in place, and ready for the installation of ITS equipment.

New conduit will be paid for under Item 618, "Conduit" or Special Specification ITS Conduit.

6.2. **Install Only.** The work performed and materials furnished in accordance with this Item and measured as provided for under "Measurement" will be paid for at the unit price bid for "ITS Ground Mount Cabinet (Install Only) of the type and configuration specified. This price is full compensation for installing ITS ground mounted cabinets furnished by the Department as shown on the plans; for forming and setting the cabinet

foundation; for furnishing and placing anchor bolts, nuts, and washers; for furnishing and placing electrical conduit in the foundation; for appropriately grounding the cabinet; and equipment, materials, labor, tools, and incidentals necessary to install an ITS ground mounted cabinet, complete in place, and ready for the installation of ITS equipment.

New conduit will be paid for under Item 618, “Conduit” or Special Specification ITS Conduit.

6.3. **Relocate.** The work performed and materials furnished in accordance with this Item and measured as provided for under “Measurement” will be paid for at the unit price bid for “ITS Ground Mount Cabinet (Relocate)” of the type and configuration specified. This price is full compensation for removing existing ground mounted cabinets as shown on the plans; removing existing foundations; backfilling and surface placement; hauling and installing ITS ground mounted cabinets; for furnishing and placing anchor bolts, nuts, and washers; for appropriately grounding the cabinet; and equipment, materials, labor, tools, and incidentals necessary to relocate an existing ITS ground mounted cabinet, complete in place, and ready for the installation of ITS equipment.

New conduit will be paid for under Item 618, “Conduit” or Special Specification ITS Conduit.

6.4. **Remove.** The work performed and materials furnished in accordance with this Item and measured as provided for under “Measurement” will be paid for at the unit price bid for “ITS Ground Mount Cabinet (Remove)” of the type and configuration specified. This price is full compensation for removing existing ITS ground mounted cabinets as shown on the plans; removing existing foundations; backfilling and surface placement; loading and hauling; and equipment, materials, labor, tools, and incidentals necessary to complete the removal of existing ITS ground mounted cabinets.

Special Specification 6010
Closed Circuit Television (CCTV) Field Equipment

1. DESCRIPTION

Furnish, install, relocate, or remove closed circuit television (CCTV) field equipment at locations shown on the plans, or as directed.

2. MATERIALS

2.1. **General Requirements.** Fabricate, provide, assemble, and install materials that are new, corrosion resistant and in strict accordance with the details shown on the plans and in the specifications.

Provide CCTV field equipment that is compatible with software currently in operation in order to interface with the existing equipment and software located in the Department's Traffic Management Control (TMC) Centers across the state.

CCTV field equipment to include the following:

- color video camera units,
- camera lenses, filters, control circuits and accessories,
- camera housing,
- medium duty pan and tilt units with click and drag position control,
- camera control receivers,
- local field control unit (if required for operation),
- video and camera control and power cable connectors and assemblies,
- video, data, and power surge suppression, and
- built-in ID generator.

2.2. **Functional Requirements for Analog CCTV.** Provide color video cameras that are solid state design and that meet the following functional requirements:

2.2.1. **General.**

2.2.1.1. **Digital Signal Processing (DSP):**

- digital zoom with manual override functionality,
- auto and manual iris control,
- auto and manual exposure control with built in frame buffer,
- auto and manual focus control, and
- built-in ID generator, with white letters on black outline minimum or approved equivalent.

2.2.1.2. **Image Pickup Device.** Single chip interline transfer solid state color matrix charge-coupled device (CCD) or complementary metal-oxide semiconductor (CMOS) sensor. Provide a sensor having a minimum of 752 (H) X 480 (V) effective pixels.

2.2.1.3. **Resolution.** Greater than 350 lines vertical and greater than 460 lines horizontal, interlaced 2:1, measured per EIA-170A Standard. No discernible interlace jitter or line pairing on the viewing monitor. System limiting resolution that conforms to FCC regulations for broadcast signals.

2.2.1.4. **Frame Rate.** Adjustable frame rate frequency up to 30 frames per second.

2.2.1.5. **Encoded NTSC Video Signal Format.** Conformance to the National Television Standards Committee (NTSC) specification and produce NTSC compatible video in accordance with EIA-170A Standard, governed by the Electronic Components Association (ECA), for video output 1 V p-p composite also known as 140 IRE units per Institute of Radio Engineers (IRE). Provide up to 16 dB automatic gain control (AGC).

2.2.1.6. **Output Impedance.** 75 ohms ± 5%.

2.2.1.7. **Aspect Ratio.** Width to height aspect ratio of 4:3.

2.2.1.8. **Image Quality.** Ability to produce clear, free from distortion, usable video images of the areas, vehicles, objects, and other subjects visible from a roadside CCTV site. Ensure that video produced by the camera is true, accurate, distortion free, and free from transfer smear, oversaturation, and any other image defect that negatively impacts image quality under all lighting and weather conditions in both color and monochromatic modes.

2.2.1.9. **Over Exposure Protection.** Minimize glare and incur no permanent damage to the camera when pointed directly at strong light sources, including the sun, for brief periods of time.

2.2.1.10. **Geometric Distortion.** Zero.

2.2.1.11. **Signal to Noise Ratio (AGC Off).** 50 dB Minimum (weighted at 4.5 MHz).

2.2.1.12. **Electronic Shutter Speed.** Automatic shutter that is user selectable down to at least 1/10,000 sec.

2.2.1.13. **Electronic Image Stabilization.** User selectable on or off electronic image stabilization at 5 Hz and 10 Hz minimum.

2.2.1.14. **Day (Color) and Night (Mono).** Auto and manual switchover and iris control with user selectable modes for auto and manual control capabilities.

2.2.1.15. **Auto White Balance.** Color quality that is maintained by a continuous through the lens automatic white balance for color temperatures from 2850 K to greater than 5100 K with less than 10 IRE units unbalance.

2.2.1.16. **Inverted Operation.** Automatic or manual activation image inversion or “flip” operation when rotating through 0° or 180° vertical tilt positions.

2.2.1.17. **Mean Time Before Failure.** A minimum of 43,800 hr. or 5 yr. without mechanical malfunction or failure. Act of God failures are exempt.

2.2.2. **Lens.** Provide an integral lens assembly for each camera with the following features:

- an f/1.6 or better glass multi-coated zoom lens with variable focal lengths with a minimum 30X zoom range,
- 10X auto and manual digital zoom minimum, and
- automatic and manual focus and iris control.

Provide lenses with capabilities for remote control of the zoom, focus, and iris operations. Mechanical or electrical means provided to protect the motors from overrunning in extreme positions. Lens and controller system capable of both auto iris and remote manual iris operation. Capabilities of lens for auto and manual zoom and focus control. Motorized iris as opposed to auto iris type, for system control capability.

2.2.3. **Network Interface Requirements.** Provide equipment that is compatible with the Department’s Lonestar™ software and can be integrated into the Department’s TMC CCTV control sub-systems through NTCIP 1205 Version 1.08 or latest Department approved version, Open Network Video Interface Forum (ONVIF), or approved equal. Support Cohu, Pelco D, Pelco P protocols, or approved equal for control.

Provide equipment that is compatible with other devices using Telecommunications Industry Association/Electronic Industries Alliance (TIA/EIA)-232 or EIA-422/485 at a rate of 9600 bps.

Provide camera equipment that supports local and remote configuration and management. Configuration and management functions must include access to all user-programmed features, including but not limited to, network configuration, video settings, device monitoring, control setting, and security functions. Configuration and management is achieved through serial login, telnet login, web-based interface, or manufacturer software. Provide manufacturer software with camera for local configuration, system maintenance and management control.

2.3. **Functional Requirements for Digital CCTV.** Provide color video cameras that produce digital video in standard definition or high definition that meet the following functional requirements:

2.3.1. **General.**

2.3.1.1. **Digital Signal Processing (DSP):**

- digital zoom,
- auto and manual iris control,
- auto and manual exposure control with built in frame buffer,
- auto and manual focus control, and
- built-in ID generator, with white letters on black outline minimum or approved equivalent.

2.3.1.2. **Image Pickup Device.** 1.2 megapixel (1,200,000 pixels), or better, progressive scan digital CCD or CMOS sensor.

2.3.1.3. **Resolution.** Support the following resolutions:

- 720p (1280 x 720 pixel array),
- D1 (720 x 480 pixel array),
- CIF (352 x 240 pixel array), and
- VGA (640 x 480 pixel array) at a minimum dependent on video stream configuration.

2.3.1.4. **Frame Rate.** Allow user selectable frame rates at 30, 15, 7, 4, 2, and 1 frames per second.

2.3.1.5. **Data Rate.** Scalable from 64 kbps to 8 Mbps

2.3.1.6. **Video Stream Format.** Allow simultaneous encoding and transmission, of a minimum, two configurable digital video streams in conformance with the Moving Picture Experts Group's MPEG-4 part 10 (H.264) and Motion JPEG (MJPEG) video compression technology in accordance with the ISO and IEC requirements detailed in the ISO/IEC 14496-10 standard or most current version. Support configuration of the following at a minimum:

- H.264,
- MJPEG,
- H.264 + H.264, and
- H.264 + MJPEG.

2.3.1.7. **Video Stream.** Support both uni-cast (one-to-one) and multi-cast (one-to-many).

2.3.1.8. **Aspect Ratio.** Support width to height aspect ratio of 4:3 or 16:9 dependent on TMC monitor video format functionality.

2.3.1.9. **Image Quality.** Ensure that video produced by the camera is true, accurate, distortion free, and free from transfer smear, oversaturation, and any other image defect that negatively impacts image quality under all lighting and weather conditions in both color and monochromatic modes.

2.3.1.10. **Wide Dynamic Range (WDR).** Operation with manual override option.

2.3.1.11. **Over Exposure Protection.** Minimize glare and incur no permanent damage to the camera when pointed directly at strong light sources, including the sun, for brief periods of time.

2.3.1.12. **Geometric Distortion.** Zero.

2.3.1.13. **Signal to Noise Ratio (AGC Off).** 50 dB minimum (weighted at 4.5 MHz).

2.3.1.14. **Electronic Shutter Speed.** Automatic shutter that is user selectable down to at least 1/10,000 sec.

2.3.1.15. **Electronic Image Stabilization.** User selectable on or off electronic image stabilization at 5 Hz and 10 Hz minimum.

2.3.1.16. **Day (Color) and Night (Mono).** Auto and manual switchover and iris control with user selectable modes for auto and manual control capabilities.

2.3.1.17. **Auto White Balance.** Color quality that is maintained by a continuous through the lens automatic white balance for color temperatures from 2850 K to greater than 5100 K with less than 10 IRE units unbalance.

2.3.1.18. **Inverted Operation.** Automatic image inversion or "flip" when rotating through 0° or 180° vertical tilt positions when not an integrated unit.

2.3.1.19. **Mean Time Before Failure.** A minimum of 43,800 hr. or 5 yr. without mechanical malfunction or failure. Act of God failures are exempt.

2.3.2. **Lens.** Provide an integral lens assembly for each camera with the following features:

- an f/1.6 or better glass multi-coated zoom lens with variable focal lengths with a minimum 18X zoom range,
- 10X auto and manual digital zoom minimum, and
- automatic and manual focus and iris control.

Provide lenses with capabilities for remote control of the zoom, focus, and iris operations. Mechanical or electrical means provided to protect the motors from overrunning in extreme positions. Lens and controller system capable of both auto iris and remote manual iris operation. Capabilities of lens for auto and manual zoom and focus control. Motorized iris as opposed to auto iris type, for system control capability.

2.3.3. **Network Interface Requirements.**

Provide CCTV field equipment that can integrate with the Department's Lonestar™ software and can be integrated into the Department's TMC CCTV control sub-systems through NTCIP 1205 Version 1.08 or higher, Open Network Video Interface Forum (ONVIF), or approved equal. Support Cohu, Pelco D or Pelco P protocols, or approved equal for control.

Provide camera equipment with a Local Area Network (LAN) connection that supports the requirements detailed in the IEEE 802.3 Standard for 10/100 Ethernet connections for half-duplex or full-duplex and provide auto negotiation. Provide equipment with a minimum of 1 Ethernet port, which has a 10/100 Base-TX connection. Provide connectors that conform to EIA and TIA requirements.

Support, at a minimum, RTP, RTSP, UDP/IP, TCP/IP, IPv4, HTTP, IGMPv2, DHCP, NTP, IEEE 802.1x, Ethernet 802.3u, and Telnet.

Provide camera equipment that supports local and remote configuration and management. Configuration and management functions must include access to all user-programmed features, including but not limited to, network configuration, video settings, device monitoring, control setting, and security functions. Configuration

and management is achieved through serial login, telnet login, web-based interface, or manufacturer software. Provide manufacturer software with camera for local configuration, system maintenance and management control.

2.4. **Cable Assembly.** Provide camera power and communication cable assembly equipped with cables used for video feed, camera control including PTZ function, communications signaling, and power supply. Camera power and communication cable can be configured as a composite cable or series of isolated cables. The following cable functions may be required depending on the data and video communication interface requirements, as shown on the plans.

2.4.1. **Serial.** Provide shielded twisted pair serial based communication cable rated for outdoor use in conformance to EIA RS-232/422/485 Standards, governed by the Electronic Components Association (ECA). Provide serial based conversion hardware, if necessary, to achieve this function.

2.4.2. **Video.** Provide coaxial cable, rated for outdoor use, between the camera and the communications equipment interface that is a mid-range RG-59/U type with a solid center conductor with 100% shield coverage, with a cellular polyethylene dielectric, or a cable as recommended by the manufacturer of the CCTV field equipment.

2.4.3. **Ethernet.** Provide a shielded twisted pair (STP) Category 5E (or equivalent) at a minimum rated for outdoor use in conformance to TIA/EIA 568B Standard. Cable must not exceed an attenuation of 30 dB per 300 ft. of cable at 100 MHz.

2.4.4. **Power.** Provide 3-wire, insulated for 300 V minimum, 115 VAC or 24 VAC power cabling between the camera and the power supply. If 24 VAC power is required, provide needed power supply conversion equipment.

Power may be achieved through Power over Ethernet (PoE) through a power supply or mid-span PoE injector, to be subsidiary to the camera unit, and must conform to the IEEE 802.3af or IEEE 802.3at standard or latest revision.

Provide power and communication cable assembly the entire length of the camera support structure from the camera to the cabinet with an additional 25 ft. of slack in the cabinet. Determine the appropriate length required for each site. The cable assembly is subsidiary to the camera unit.

Provide any necessary data, video, or power conversion hardware necessary to successfully integrate the camera unit into the field equipment cabinet hardware components and onto the communications backbone.

2.5. **Video Encoding Interoperability.** Digital video encoders and decoders are necessary to convert the analog signal to digital, transport digital packets via UDP/IP over fiber optic, copper Ethernet, wireless, or leased line networks and convert the digital packets back to an analog signal for viewing on a display monitor. Video encoding and decoding equipment may be achieved through software or hardware means. Ensure camera's encoded video is interoperable with hardware and software decoders from other manufacturers. Ensure the camera's encoded video can be decoded by a minimum of two other manufacturer's software or hardware decoders that are currently in use by the Department. Contact the Department for decoders supported prior to procurement of camera unit.

2.6. **Camera Housing.** Provide camera housing assembly and hardware material that reflects sunlight.

Provide camera housing with a sunshield to reduce the solar heating of the camera. The total weight of the camera (including housing, sunshield, and all internal components) must not exceed 35 lb.

Construct viewing window in such a way that unrestricted camera views can be obtained at all camera and lens positions.

Provide gaskets at cable entry point to the camera housing to prevent moisture or dust entry.

When shown on the plans or identified in the general notes, provide heating or cooling functionality with temperature sensors to maintain internal temperatures within the manufacturer required operating temperature range.

2.7. **Pan-Tilt Unit.** Furnish and install a medium duty anodized aluminum weatherproof pan-tilt-unit at each camera site, conforming to National Electrical Manufacturer's Association (NEMA) 4X and IP-66 rating or better, when not integral to the camera unit and housing. Provide mounting adapter and required attachment hardware to install the pan-tilt-unit to the pole or mounting bracket. Identify the type of mounting bracket and bolt pattern on shop drawings.

Provide a unit capable of a minimum of 180° vertical range of movement and horizontal movement of 360°, full, continuous rotation movement.

Provide a unit that has a pan and tilt speed of 20° per second minimum and is user adjustable through the full speed range. Unit must be capable of simultaneous pan-tilt movements with variable pan-tilt positioning control allowing variable speeds that are proportional through the zoom range.

Provide pan-tilt unit with a drive accuracy and drive repeatability of less than 1° and has an automatic pre-position speed of 120° per second minimum to a user defined preset position that is user adjustable.

Provide a pan-tilt unit, when not integral to the camera housing, capable of maintaining static position and does not move by more than 1.0° in any direction in speeds greater than 35 mph.

Ensure that the pan-tilt unit has seals and gaskets to protect the motors, gears, and cables and that the seals and gaskets are resistant to ozone, ultraviolet radiation, and other pollutants inherent to all local environmental conditions.

When shown on the plans or identified in the general notes, provide pan-tilt unit with heater that conforms to NEMA 4X standard when not integral to the camera unit and housing.

2.8. **Preset Functions.** Provide a camera unit capable of storing a minimum 62 presets for pan, tilt, zoom, and focus settings.

Provide a camera unit capable of user programmable tours with a minimum of 4 tours of up to 32 presets per tour. Any tours may be programmed for panning tours.

Provide a camera unit capable of user programmable sector zones with a minimum of 8 zones allowing right and left pan limitations.

Provide a camera unit capable of user programmable privacy zones with a minimum of 8 zones. Capable of click and drag position control through software.

2.9. **Control Receivers.** Provide a camera unit with an integrated camera control receiver, unless otherwise directed, that will execute all camera and lens functions as well as forward communication of commands for the pan-tilt functions to the pan-tilt control receiver. Mount the pan-tilt control receiver inside the pan-tilt unit.

The control receiver receives the data from the camera controller, it decodes the digital command data signals transmitted through the communication transmission interface, checks for errors, and acts on valid data to drive the pan-tilt unit and the camera controls.

Local field control is achieved through compatible control software on a laptop or through local control unit hardware located inside the field cabinet that can be EIA 19 in. rack or shelf mountable. Document that the camera control receiver and pan-tilt control receiver will execute all camera, lens, and pan-tilt functions through a laptop interface or through use of the local control unit hardware. Provide local control unit hardware only when shown on the plans or identified in the general notes.

2.10. **Connectors.** Provide and install connectors that are compatible with the communications equipment interfaces identified in Article 2.3.3 and Article 2.4. Supply all mating connectors. Provide all connector pins and mating connectors that are plated to achieve good electrical connection and resistance to corrosion.

2.11. **Source ID Generator.** Use a built-in ID Generator to insert camera ID over each of the camera-generated videos.

Provide a minimum of 2 lines of alpha numeric, case specific, text supporting a minimum of 20 ASCII characters per line, with a minimum character height of 20 pixels, that is user programmable for displaying any combination of ID information consisting of camera, preset, privacy mask, low pressure warning, compass, and time and date at a minimum.

Allow user selectable location of text to be displayed on the video image at the extreme top or bottom. Text display on the side of the image display prohibited .

Automatically display the programmed ID with its associated video signal that can be turned on or off by user command.

In the event of loss of signal or video signal failure, ID Generator automatically passes through failure message to display over video.

Submit list of available text displays to the Department as part of documentation requirements.

2.12. **Cabinet Installation.** Install video communication equipment in a pole mounted equipment cabinet or in a ground mounted equipment cabinet as shown on the plans. Meet the following criteria:

Contains all the lightning protection devices for data and video.

Grounded to earth ground.

Provide connectors for all inputs and outputs for data and video and additional ports for testing video and communications. Use the external connectors for testing and for connections to communication devices.

2.13. **Surge Protection.** Provide surge protection for the camera meeting the following requirements:

- mounting adapter – Electrically bonded to mounting structure,
- pan-tilt mechanism – Electrically bonded to mounting adapter,
- camera housing – Electrically bonded to pan-tilt mechanism, and
- power and control cable surge protector – Integrated into cabinet surge protection system.

2.14. **Power Requirements.** Provide CCTV field equipment meeting all of its specified requirements when the input power is 115 VAC ± 20%, 60 Hz ± 3 Hz, and that maximum power required does not exceed 200 W including optional equipment.

Provide appropriate voltage conversion, power injectors, or other power supply hardware if the camera equipment or any camera-related ancillary devices requires operating voltages other than 115 VAC ± 20%, such as 24 VAC, 12 VDC from solar power systems, or rely on PoE. Appropriate voltage converters or injectors must accept an input voltage of 115 VAC or 12 VDC from solar power systems as shown on the plans.

2.15. **Primary Input Power Interruption.** Provide CCTV field equipment that meets all the requirements in Section 2.1.4., “Power Interruption” of the NEMA Standard TS2 for Traffic Control System, or most current version.

2.16. **Power Service Transients.** Provide CCTV Field Equipment that meets the requirements for Section 2.1.6., “Transients, Power Service” of the NEMA Standard TS2, or most current version.

2.17. **Power Service Protection.** Provide equipment that contains readily accessible, manually resettable or replaceable circuit protection devices (such as circuit breakers or fuses) for equipment and power source protection. Provide circuit breakers or fuses sized appropriately such that no wire, component, connector, PC board or assembly is subjected to current loads in excess of their respective design limits upon failure of any single circuit element or wiring.

2.18. **Modular Design.** Provide CCTV field equipment hardware installed inside the cabinet that is modular in design that can be either shelf mountable or EIA 19 in. rack mountable. Clearly identify modules and assemblies with name, model number, serial number and any other pertinent information required to facilitate equipment maintenance.

2.19. **Connectors and Harnesses.** Make all external connections by means of connectors that are uniquely keyed to preclude improper hookups. Color-code and appropriately label with UV resistant material all wires to and from the connectors. Provide connecting harnesses of appropriate length and terminated with matching connectors for interconnection with the communications system equipment. Provide plated pins and mating connectors to improve conductivity and are corrosion resistant. All connectors utilizing solder type connections must have each soldered connection covered by a piece of heat shrink tubing securely shrunk to protect the connection for short circuiting.

Provide a wiring diagram detailing wire function and connector pin-out.

2.20. **Environmental Design Requirements.** Provide equipment that conforms to NEMA TS2-2003 (R2008), International Electrotechnical Commission (IEC) 60529, and NEMA 250-2008, or most current version, for the following categories:

2.20.1. **Temperature.** Provide equipment that conforms to NEMA TS2 Section 2.1.5.1, or latest revision, and meets all the specified requirements during and after being subjected to any combination of the following conditions:

- ambient temperature range of -30 to 165°F,
- temperature shock not exceeding 30°F per hour,
- relative humidity of 0 to 100%,
- moisture condensation on all exterior surfaces caused by temperature changes, and
- provisions for a heater and blower function will be required to maintain internal temperatures within the manufacturer's operating temperatures for temperature ranges internal to the camera unit not conforming to NEMA TS2 Standard 2.1.5.1.

2.20.2. **Vibration.** Provide equipment that conforms to NEMA TS2 Section 2.1.9 and Section 2.2.3, or most current version, and meets all the specified requirements during and after being subjected to a vibration of 5 to 30 Hz up to 0.5 g applied in each of three mutually perpendicular planes for 30 min.

2.20.3. **Shock.** Provide equipment that conforms to NEMA TS2 Section 2.1.10 and Section 2.2.4, or most current version, and does not yield permanent mechanical deformation or any damage that renders the unit inoperable when subjected to a shock of 10 g applied in each of three mutually perpendicular planes for 30 min.

2.20.4. **Environmental Contaminants.** Provide equipment that conforms to IEC 60529 Section 14.2.6, ormost current version, for IP 66 or greater rating when providing a pressurized unit.

Provide equipment that conforms to IEC 60529 Section 14.2.7, ormost current version, for IP 67 or greater rating when providing a non-pressurized unit.

2.20.5. **External Icing.** Provide equipment that is tested to conform to NEMA 250-2003 Section 5.6, or latest revision.

2.20.6. **Corrosion.** Provide equipment that is tested to conform to NEMA 250-2003 Section 5.10, or latest revision, when located in coastal Districts. Coastal Districts are Beaumont (BMT), Corpus Christi (CRP), Houston (HOU), Pharr (PHR), and Yoakum (YKM).

2.20.7. **Wind Rating.** Operational in adverse weather conditions and able to withstand wind loads in accordance with Department's basic wind velocity zone map standard as shown on the plans without permanent damage to mechanical and electrical equipment.

3. CONSTRUCTION

3.1. **General.** Maximize standardization and consistency by utilizing industry standard techniques in equipment design and construction, with the minimum number of parts, subassemblies, circuits, cards, and modules. Design equipment for ease of maintenance.

Provide mounting bracket assemblies or apparatus to mount equipment on the following structures as detailed in the plans or on the ITS standards:

- ITS Pole,
- overhead sign bridge or cantilever overhead sign structure ,
- retaining wall, and
- concrete column or parapet.

Provide mounting bracket design with documentation submittal for approval prior to fabrication. Include all mounting plates, screws, bolts, nuts, washers, and ancillary hardware needed to fabricate the entire mounting bracket.

3.2. **Mechanical Components.** Provide stainless steel external screws, nuts and locking washers. Self-tapping screws are not acceptable.

Provide parts that are made of corrosion resistant material; examples include: plastic, stainless steel, anodized aluminum, or brass.

Protect all materials used in construction from fungus growth and deterioration due to sustained moisture.

Separate dissimilar metals by an inert dielectric material.

3.3. **Wiring.** Provide wiring that meets the requirements of the National Electrical Code (NEC) most current version. Provide wires that are cut to proper length before assembly. It is not acceptable to "double-back" wires to take up slack inside the cabinet. Lace wires neatly with nylon lacing or plastic straps. Organize cables neatly inside the cabinet and secure cables with clamps. Provide service loops at connection points when connecting to hardware inside the cabinet. No splicing of cables or exposed wiring is allowed. Clearly label all wiring.

3.4. **Relocation of CCTV Field Equipment.** Perform the relocation in strict conformance with the requirements herein and as shown on the plans. Completion of the work will present a neat, workmanlike, and finished appearance. Maintain safe construction practices during relocation.

Inspect the existing CCTV field equipment, with a representative from the Department, and document any evidence of damage prior to removal. Conduct a pre-removal test in accordance with the testing requirements contained in this Item to document operational functionality. Remove and deliver to the Department, existing CCTV field equipment that fail inspection.

Prior to removal of existing CCTV field equipment, disconnect and isolate the power cables from the electric power supply and disconnect all communication cabling from the equipment located inside the cabinet. Coil and store power and communication cabling inside the cabinet until such time that it can be relocated.

Remove existing CCTV field equipment as shown on the plans only at such time as authorized by the Engineer.

Use care to prevent damage to any support structures. Any portion of CCTV field equipment or camera pole structure damaged or lost will be replaced by the Contractor at his expense. Contractor to document and report to the Department any existing damage to equipment prior to removal.

Make all arrangements for connection to the power supply and communication source including any permits required for the work to be done under the Contract. Provide wire for the power connection at least the minimum size indicated on the plans and insulated for 600 V. Meet the requirements of the NEC most current version.

3.5. **Removal of CCTV Field Equipment.** Disconnect and isolate any existing electrical power supply prior to removal of existing CCTV field equipment,

Perform removal in strict conformance with the requirements of this Specification, and the lines, grades, details and dimensions shown on the plans. Completion of the work will present a neat, workmanlike, and finished appearance.

Any portion of the CCTV field equipment or cabinet internal components damaged or lost will be replaced by the Contractor (with items requiring the approval of the Engineer) at no cost to the Department.

All materials not designated for reuse or retention by the Department will become the property of the Contractor and be removed from the project site at the Contractor's expense. Deliver items to be retained by the Department to a location shown on the plans or general notes. The Contractor is fully responsible for any removed equipment until released by the Engineer.

3.6. **Contractor Experience Requirements.** Contractor or designated subcontractor must meet the following experience requirements:

3.6.1. **Minimum Experience.** Three years of continuous existence offering services in the installation of CCTV camera systems.

3.6.2. **Completed Projects.** Three completed projects consisting of a minimum of 5 cameras in each project where the personnel installed, tested and integrated CCTV cameras on outdoor, permanently mounted structure(s) and related camera control and transmission equipment. The completed CCTV camera system installations must have been in continuous satisfactory operation for a minimum of 1 yr.

3.6.3. **Equipment Experience.** Three projects (may be the three in the preceding paragraph) in which the personnel worked in cooperation with technical representatives of equipment suppliers to perform specific stages of work. The Contractor will not be required to furnish equipment on this project from the supplier who furnished documentation demonstrating this experience.

Submit the names, addresses and telephone numbers of the references that can be contacted to verify the experience requirements given above.

3.7. **Documentation Requirements.** Provide a minimum of 2 complete sets of operation and maintenance manuals in bound hard copy format, as well as an electronic copy in Adobe PDF format on a CD/DVD or removable flash drive that include the following:

- complete and accurate wiring schematic diagrams,
- complete installation procedures,
- compliance matrix documenting conformance to this specification,
- complete performance specifications (Functional, electrical, mechanical and environmental) on the unit,
- complete parts list including names of vendors for parts not identified by universal part number such as JEDEC, RETMA, or EIA,

- pictorial of component layout on circuit board,
- ID Generator list of text display options,
- complete maintenance and trouble-shooting procedures,
- complete stage-by-stage explanation of circuit theory and operation,
- testing procedures and blank test forms,
- recovery procedures for malfunction,
- instructions for gathering maintenance assistance from manufacturer, and
- provide the Department with certification documentation verifying conformance with environmental and testing requirements contained in the special specification. Certifications may be provided by the manufacturer or through independent labs.

Identify material which is copyrighted or proprietary in nature as part of the documentation submittal. The Department will comply with sensitive material and secure submittal documentation and not distribute without written approval.

3.8. **Testing.**

3.8.1. **New Installations.** Unless otherwise shown on the plans, perform the following tests on the applicable equipment or systems.

3.8.1.1. **Test Procedures Documentation.** Provide 5 copies of the test procedures to include tests identified in Article 5.1.2 through Article 5.1.7 inclusive and blank data forms to the Engineer for review and comment as part of material documentation requirements for each test required on this project. Include the sequence of the tests in the procedures. The Engineer will comment, approve, or reject test procedures within 30 days after Contractor submittal of test procedures. Contractor to resubmit if necessary rejected test procedures for final approval within 10 days. Review time is calendar days. Conduct all tests in accordance with the approved test procedures.

Record test data on the data forms, as well as quantitative results. No bid item measurement or payment will be made until the Engineer has verified the test results meet the minimum requirements of the specification. The data forms for all tests, except design approval tests, must be signed by an authorized representative of the Contractor.

Provide written notice to the Engineer within 48 hr. of discovery of any testing discrepancy identified during testing by the Contractor. Furnish data forms containing the acceptable range of expected results as well as the measured values.

3.8.1.2. **Design Approval Test.** Conduct a design approval test on one randomly selected unit from the prototype design manufacturing run. If only 1 design prototype is manufactured, perform this test on that unit. If supplying multiple types of the equipment, provide and test a sample of each type.

Certification from an independent testing laboratory of a successfully completed design approval test is acceptable. Ensure that the testing by this laboratory is performed in accordance with the requirements of this specification. Failure of independent tests to comply with the requirements of this specification will be grounds for rejection of any certification.

Provide a copy of the certification to the District in which this contract is executed. The data forms for the design approval tests must be signed by an authorized representative (company official) of the equipment manufacturer or by an authorized representative of an independent testing facility.

Notify the Engineer 10 working days before conducting this testing. The Department may witness all the tests. Perform the following tests:

3.8.1.2.1. **Power Service Transients.** Provide equipment that meets the performance requirements, specified in this Item, when subjected to the power service transients as specified in Section 2.2.7.2, “Transient Tests (Power Service)” of the NEMA TS2 standard, most current version.

3.8.1.2.2. **Temperature and Condensation.** Provide equipment that meets the performance requirements, specified in this Item, when subjected to the following conditions in the order specified below:

- stabilize the equipment at -30°F and test as specified in Sections 2.2.7.3, “Low-Temperature Low-Voltage Tests” and 2.2.7.4, “Low-Temperature High-Voltage Tests” of the NEMA TS2 standard, most current version
- allow the equipment to warm up to room temperature in an atmosphere having relative humidity of at least 40%. Operate the equipment for 2 hr., while wet, without degradation or failure, and
- stabilize the equipment at 165°F and test as specified in Sections 2.2.7.5, “High-Temperature High Voltage Tests” and 2.2.7.6, “High-Temperature Low-Voltage Tests” of the NEMA TS2 standard, most current version.

3.8.1.2.3. **Relative Humidity.** Provide equipment that meets the performance requirements, specified in this Item, within 30 min. of being subjected to a temperature of 165°F and a relative humidity of 18% for 48 hr.

3.8.1.2.4. **Vibration.** Provide equipment that shows no degradation of mechanical structure, soldered components, or plug-in components and operates in accordance with the manufacturer's equipment specifications after being subjected to the vibration tests as described in Section 2.2.8, “Vibration Test” of the NEMA TS2 standard, most current version.

3.8.1.2.5. **Power Interruption.** Provide equipment that meets the performance requirements, specified in this Item, when subjected to nominal input voltage variations as specified in Section 2.2.10 “Power Interruption Test” of the NEMA TS2 standard, most current version.

3.8.1.3. **Demonstration Test.** Conduct a demonstration test on applicable equipment at an approved Contractor facility. The Contractor may submit procedures and results from previous contracts in the same District as this Contract provided the materials and equipment are identical, provided results are less than 5 yr. old. Notify the Engineer 10 working days before conducting this testing. The Department may witness all the tests. Perform the following tests:

3.8.1.3.1. **Examination of Product.** Examine each unit carefully and document that the materials, design, construction, markings and workmanship comply with the requirements of this Item.

3.8.1.3.2. **Continuity Tests.** Check the wiring to determine conformance with the requirements of the appropriate paragraphs in this Item.

3.8.1.3.3. **Operational Test.** Operate each unit for at least 15 min. to permit equipment temperature stabilization and an adequate number of performance characteristics to ensure compliance with the requirements of this Item.

3.8.1.4. **Field Acceptance (Stand-Alone) Test.** Conduct a field acceptance test for each unit after installation as required by the Engineer in order to demonstrate compliance with the functional requirements with this Item. Exercise all stand-alone (non-network) functional operations. Notify the Engineer 5 working days before conducting this test. The field acceptance test may consist of the following:

3.8.1.4.1. **Physical Construction.** Document physical construction is completed in accordance with the plans and specification.

3.8.1.4.2. **Electrical and Communication.** Document that all connectors for grounding, surge suppression, and electrical distribution are tightened correctly. Document all power supplies and circuits are operating under the proper voltages. Document all power and communications cables are terminated correctly, secured inside the cabinet, and fitted with appropriate connectors.

3.8.1.4.3. **Video Signal.** For analog signal format, conduct an impedance test, through a short 75 ohm coaxial cable, to an oscilloscope waveform monitor to ensure 75 ohm output impedance to conform with NTSC standards.

Through use of a digital, hand-held, battery operated meter, conduct a test and measure the following video signal characteristics, if applicable:

3.8.1.4.3.1. **Sync.** Document the amplitude of the video synchronizing pulse and check for correct video level, coaxial cable continuity, and correct termination level is 40 IRE.

3.8.1.4.3.2. **Luminance.** Document the white level and correct brightness setting is 100 IRE.

3.8.1.4.3.3. **Composite.** Document the overall amplitude of the video signal is at 140 IRE or 1 V peak to peak.

3.8.1.4.3.4. **Color Burst.** Document color burst amplitude at 40 IRE.

3.8.1.4.3.5. **Ground-loop.** Document that no ground loop exists in the video picture. Ground loop voltages in the video signal causes bars to be present on the video picture.

Document video image is present and free from over-saturation and any other image defect in both color and monochrome modes.

Document video support of unicast and multicast video transmission modes.

Document the video signal from the camera is present and of consistent quality at all connection points between the camera, the cabinet, and any video conversion hardware.

3.8.1.4.4. **Communication.** For digital camera models, document network connection to the camera through ping or telnet session from a remote PC. For analog camera models, document serial data transmission to execute control through serial ports.

3.8.1.4.5. **Pan-Tilt Mechanism.** Exercise pan, tilt, zoom, and focus in all directions and execute a minimum of 3 other unique programming commands, specified by the Department, to ensure that the communication link between the cabinet and the camera is functioning properly.

3.8.1.5. **System Integration Test.** Conduct a system integration test on the complete functional system. Demonstrate all control and monitor functions for each system component for 72 hr. Notify the Engineer 10 working days before conducting this testing. The Department may witness all the tests.

Provide systems integration test procedures for proper adjustment and calibration of subsystem components. Proper adjustment and calibration involves documenting settings used to meet functional requirements while providing a margin for adjustment when future conditions change. Utilize the Department control software (when available) to perform subsystem testing. At a minimum, utilize this software to verify commands and confirms, as well as, detector actuations and occupancy dwell time. The Contractor is responsible for being familiar with any existing Department equipment and software.

The failure of any one component material or equipment item in a system integration test is justification for rejecting the entire subsystem. Each subsystem component must function as a complete integrated subsystem for a minimal continuous 72 hr. period during the system integration test.

3.8.1.6. **Final Acceptance Test.** Following completion of the demonstration test, standalone test, and system integration test for all subsystems, provide completed data forms containing all of the data taken, including quantitative results for all tests, a set of “as built” working drawings, and a written request to begin a data communication and final acceptance test. Provide “as built” working drawings indicating the actual material, equipment, and construction of the various subsystem components, including established and calculated XY coordinates based on project control points provided by the Engineer, when shown on the plans. Perform field surveying and calculations under the supervision of and sealed by a licensed land surveyor.

Within 10 calendar days of the request, execute a data communications test using a Department supplied software program or Contractor supplied software approved by the Department. The data communications test may be executed by the Engineer or the Contractor with the prior approval of the Engineer. The purpose of this test is to verify that the communications plant will operate with application software provided by the State.

Perform the data communications test for a period of 72 hr. If a message error or component failure occurs anywhere in the network, resume the test once repairs are completed. All components of the communications network must operate as an integral system for the duration of the test.

A message error is defined as the occurrence of a parity error, framing error, or data error in any component of the message. The error free message rate is defined as the ratio of the number of messages in which no message error occurs to the number of messages transmitted. The error free message rate must exceed 99.99% for acceptable transmission quality, both for the system as a whole, and for each component of the network.

Provide all additional test results to the Engineer for review once a successful data communications test has been completed. If all the requirements of this specification have been satisfied, contract time will stop and all subsystems will be placed into operation and operate as a complete system for a period of 90 days.

Notify the Engineer of any defects suspected in integration or function of material or equipment. Investigate any suspected defects and correct if necessary. Provide a report of finding within 2 calendar days of notice of any suspected defects. Describe the nature of the any defects reported and any corrective action taken in the report. The integrated subsystems must operate defect free as a single complete system for a minimum of 72 continuous hours during a 30 calendar day review period. If the number of defects or frequency of failures prevents any subsystems from operating as described above, the Engineer may reject the entire subsystem(s) integration test results and resume contract time. Provide any necessary corrections and resubmit subsystem(s) integration test results and a request to begin a final acceptance test which may include “as built” plans and a data communications test.

The CCTV field equipment under this Item will not be accepted until the system, inclusive of all subsystems, has operated satisfactorily for a period of 90 days and in full compliance with the plans and specifications after approval of all submitted test results and reports.

3.8.1.7. **Consequences of Test Failure.** If a unit fails a test, submit a report describing the nature of the failure and the actions taken to remedy the situation prior to modification or replacement of the unit. If a unit requires modification, correct the fault and then repeat the test until successfully completed. Correct minor discrepancies within 30 days of written notice to the Engineer. If a unit requires replacement, provide a new unit and then repeat the test until successfully completed. Major discrepancies that will substantially delay receipt and acceptance of the unit will be sufficient cause for rejection of the unit.

Failure to satisfy the requirements of any test is considered a defect and the equipment is subject to rejection by the Engineer. The rejected equipment may be offered again for retest provided all noncompliance has been corrected.

If a failure pattern develops in similar units within the system, implement corrective measures, including modification or replacement of units, to all similar units within the system as directed. Perform the corrective measures without additional cost or extension of the contract period.

3.8.1.7.1. **Consequences of Design Approval Test Failure**. If the equipment fails the design approval test, correct the fault within 30 days and then repeat the design approval test until successfully completed.

3.8.1.7.2. **Consequences of Demonstration Test Failure.** If the equipment fails the demonstration test, correct the fault within 30 days and then repeat the demonstration test until successfully completed.

3.8.1.7.3. **Consequences of Field Acceptance (Stand-Alone) Test Failure.** If the equipment fails the stand-alone test, correct the fault within 30 days and then repeat the stand-alone test until successfully completed.

3.8.1.7.4. **Consequence of System Integration Test Failure.** If the equipment fails the system integration test, correct the fault within 30 days and then repeat the systems integration test until successfully completed.

3.8.1.7.5. **Consequences of Final Acceptance Test Failure.** If a defect within the system is detected during the final acceptance test, document and correct the source of failure. Once corrective measures are taken, monitor the point of failure until a 30 consecutive day period free of defects is achieved.

If after completion of the initial test period, the system downtime exceeds 72 hr. or individual points of failure have not operated for 30 consecutive days free of defects, extend the test period by an amount of time equal to the greater of the downtime in excess of 72 hr. or the number of days required to complete the performance requirement of the individual point of failure.

3.8.2. **Relocation and Removal.**

3.8.2.1. **Pre-Test.** Provide 5 copies of the test procedures to include tests of the basic functionality of the unit and blank data forms to the Engineer for review and comment as part of material documentation requirements. Functionality tests may include, but are not limited to, physical inspection of the unit and cable assemblies, lens iris and zoom control, video signal, and pan-tilt mechanism. Include the sequence of the tests in the procedures along with acceptance thresholds. The Engineer will comment, approve, or reject test procedures within 30 days after Contractor submittal of test procedures. Contractor to resubmit if necessary rejected test procedures for final approval within 10 days. Review time is calendar days. Conduct all tests in accordance with the approved test procedures.

Conduct basic functionality testing prior to removal of CCTV field equipment. Test all functional operations of the equipment in the presence of representatives of the Contractor and the Department. Ensure that both representatives sign the test report indicating that the equipment has passed or failed each function. Once removed, the equipment becomes the responsibility of the Contractor until accepted by the Department. Compare test data prior to removal and test data after installation. The performance test results after relocation must be equal to or better than the test results prior to removal. Repair or replace those components within the system which failed after relocation but which passed prior to removal.

3.8.2.2. **Post Test.** Testing of the CCTV field equipment is for the purpose of relieving the Contractor of maintenance of the system. The Contractor will be relieved of the responsibility for maintenance of the system in accordance with Item 7, “Legal Relations and Responsibilities”, after a successful test period. The Contractor will not be required to pay for electrical energy consumed by the system.

After all existing CCTV field equipment has been installed, conduct approved continuity, stand alone, and equipment system tests. Furnish test data forms containing the sequence of tests including all of the data taken as well as quantitative results for all tests. Submit the test data forms to the Engineer at least 30 days prior to the day the tests are to begin. Obtain Engineer’s approval of test procedures prior to submission of equipment for tests. Send at least 1 copy of the data forms to the Engineer.

Conduct an approved stand-alone test of the equipment installation at the field site(s). At a minimum, exercise all stand-alone (non-network) functional operations of the field equipment with all of the equipment installed per the plans as directed by the Engineer. Complete the approved data forms with test results and turn over to the Engineer for review and either acceptance or rejection of equipment. Give at least 30 working days notice prior to all tests to permit the Engineer or his representative to observe each test.

The Department will conduct approved CCTV field equipment system tests on the field equipment with the central equipment. The tests will, as a minimum, exercise all remote control functions and display the return status codes from the controller.

If any unit fails to pass a test, prepare a report and deliver it to the Engineer. Describe in the report the nature of the failure and the corrective action needed. If the failure is the result of improper installation or damage during reinstallation, reinstall or replace the unit and repeat the test until the unit passes successfully, at no additional cost to the Department or extension of the Contract period.

3.9. **Warranty.** Warrant the equipment against defects or failure in design, materials, and workmanship for a minimum of 3 yr. or in accordance with the manufacturer's standard warranty if that warranty period is greater. The start date of the manufacturer's standard warranty will begin after the equipment has successfully passed all tests contained in the final acceptance test plan. Any CCTV field equipment with less than 90% of its warranty remaining after the final acceptance test is completed will not be accepted by the Department. Guarantee that equipment furnished and installed for this project performs according to the manufacturer's published specifications. Assign, to the Department, all manufacturer's normal warranties or guarantees on all electronic, electrical, and mechanical equipment, materials, technical data, and products furnished for and installed on the project.

CCTV field equipment will be repaired or replaced at the Contractor's expense prior to completion of the final acceptance test plan in the event of a malfunction or failure. Furnish replacement parts for all equipment within 10 days of notification of failure by the Department.

3.10. **Training.** Conduct a training class for a minimum of 24 hr., unless otherwise directed, for up to 10 representatives designated by the Department on procedures of installation, operations, programming hardware settings, IP programming, port settings, testing, maintenance, troubleshooting, and repair of all equipment specified within this specification. Submit to the Engineer for approval, 10 copies of the training material at least 30 days before the training begins. Conduct training within the local area unless otherwise authorized by the Engineer. Consider operations through Department's Lonestar software when developing training modules.

4. MEASUREMENT

This Item will be measured by each CCTV field equipment unit and mounting apparatus furnished, installed, relocated, or removed, of the types specified as shown on the plans, or as directed.

5. PAYMENT

5.1. **Furnish and Install.** The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit bid price for "CCTV Field Equipment (Analog)", "CCTV Field Equipment (Digital)", and "CCTV Field Controller". This price is full compensation for making fully operational CCTV field equipment including any voltage converters or injectors, cables and connectors as shown on the plans; and all documentation, testing, training, software, equipment, labor, materials, tools, and incidentals.

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" for CCTV field equipment mounting assemblies will be paid for at the unit bid price for "CCTV Mount (Pole)", "CCTV Mount (Post)", "CCTV Mount (Wall)", "CCTV Mount (Parapet)", "CCTV Mount (Pendant)", and "CCTV Mount (Mast)". This price is full compensation for furnishing and installing mounting bracket assemblies, mounting bracket hardware; and all equipment, labor, materials, tools, equipment, and incidentals necessary to mount CCTV field equipment to mounting structures as shown on the plans.

5.2. **Install Only.** The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit bid price for "CCTV Field Equipment (Analog) (Install Only)" and "CCTV Field Equipment (Digital) (Install Only)." This price is full compensation for making fully operational CCTV field equipment including any voltage converters or injectors, furnishing and installing additional cables and connectors as shown on the plans; and all documentation, testing, training, software, equipment, labor, materials, tools, and incidentals.

5.3. **Relocate.** The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" for relocation of CCTV field equipment will be paid for at the unit bid price for "Relocate CCTV Field Equipment." This price is full compensation for relocating and making fully operational existing CCTV field equipment as shown on the plans; furnishing and installing additional cables or connectors as shown on the plans; for testing, delivery and storage of components designated for salvage or reuse; and all testing, training, software, equipment, labor, materials, tools, and incidentals.

5.4. **Remove.** The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" for removal of CCTV field equipment will be paid for at the unit bid price for "Remove CCTV Field Equipment." This price is full compensation for removing existing CCTV field equipment as shown on the plans; removal of cables and connectors; for testing, delivery and storage of components designated for salvage; and all testing training, software, equipment, labor, materials, tools, and incidentals.

Special Specification 6016

Intelligent Transportation System (ITS) Multi-Duct Conduit

1. DESCRIPTION

Furnish and install Intelligent Transportation System (ITS) multi-duct conduit identified for fiber optic communication use of the type and size specified. Provide conduit suitable for installation in an outdoor underground environment including constant immersion in water, mounted to retaining walls, and mounted above ground on the underside of a bridge without any degradation to the conduit.

2. MATERIALS

Provide new materials that comply with the details shown on the plans, the requirements of this Item, and the requirements of the following Items:

- Item 400, “Excavation and Backfill for Structures,”
- Item 401, “Flowable Fill,”
- Item 402, “Trench Excavation Protection,”
- Item 421, “Hydraulic Cement Concrete,”
- Item 445, “Galvanizing,”
- Item 476, “Jacking, Boring, or Tunneling Pipe or Box,”
- Item 618, “Conduit,” and
- Item 620, “Electrical Conductors”.

In addition, provide ITS multi-duct conduit meeting the requirements of the following Items:

- Underwriters Laboratories (UL) 651,2420, and 2515,
- National Electrical Manufacturers Association (NEMA) Standard TC-2,
- NEMA TC-7,
- NEMA TC-14B,
- National Electrical Code (NEC), and
- Departmental Materials Specification DMS 11030, “Conduit”.

Provide underground ITS multi-duct conduit materials that have been tested and listed as defined in the NEC for the specific use to meet the following industry standards:

- Bellcore/Telcordia Technologies document GR-356,
- American Society for Testing and Materials (ASTM)-D1784, Standard Specification for Rigid (PolyVinyl Chloride) (PVC) Compounds and (Chlorinated Poly Vinyl Chloride) (CPVC) Compounds,
- ASTM-D1785, Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120,
- ASTM-D2122, Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings,
- ASTM-F2160, Standard Specification for Solid Wall High Density Polyethylene (HDPE) Conduit Based in Controlled Outside Diameter,
- ASTM-D2412, Standard Test Method for Determination of External Loading, and
- ASTM-D3350, Standard Specification for Polyethylene Plastic Pipe and Fittings Materials.

Provide above ground ITS multi-duct conduit materials that have been tested and listed as defined in the NEC for the specific use to meet the following industry standards:

- ASTM-A90, Standard Test Method for Weight of Coating on Iron and Steel Articles with Zinc-Alloy Coatings,
- ASTM-D2105, Standard Test Method for Longitudinal Tensile Properties of “Fiberglass” (Glass-Fiber-Reinforced Thermoplastic-Resin) Pipe and Tube, and
- ASTM-D2444, Standard Test Method for Determination of the Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight).

3. EQUIPMENT

3.1. **General Requirements.**

3.1.1. **Pre-Assembled Multi-Duct.** Provide a pre-assembled multi-duct conduit system of the material type specified with a nominal 4 in. inner diameter round outer duct containing 4 factory installed 1.25 in. nominal diameter round inner ducts. Inner ducts must be held together in a square configuration by a system of spacers. The design of the spacers, which hold the individual conduits in formation, must be capable of locking them tightly together to prevent free twisting of the inner ducts.

For pre-assembled multi-duct, provide a single protective end cap for each bundled 10 ft. or 20 ft. conduit sections, factory bends, and fittings.

3.1.2. **Fittings**. Provide all required sweeps, bends, repair couplings, ground box termination kits, alternative outer ducts, adapters, preassembled split repair kits, lubrication access fittings, tug-plugs, slit-inner duct plugs, hangers, brackets, expansion joints, and accessories to complete the conduit system as incidentals.

3.1.3. **Flexural Modulus.** Do not exceed the ovality of the conduit system by 5%.

3.1.4. **Environmental Requirements.**

For underground construction, provide conduit that will perform in an ambient temperature range of -30ºF to 122ºF without degradation of material properties In accordance with the NEC.

For above ground conduit construction, provide conduit that performs in an ambient temperature range of -60ºF to 200ºF without degradation of material properties.

3.1.5. **Corrosion Resistance.** Provide a conduit system that is resistant to most harsh chemicals and protected against degradation due to oxidation or general corrosion.

3.1.6. **Direct Bury**. Provide a conduit system capable of being installed by trenching or boring as shown on the plans.

3.1.7. **Free of Defects.** Provide a conduit system free of visible cracks, holes, or other physical defects that would degrade its performance.

3.1.8. **Uniformity**. Provide conduit that is uniform as practical in respect to overall dimensions, color, density, and thickness.

3.1.9. **Stabilization.** Provide conduit with a UV light stabilizer which will protect it, for a minimum of 12 mo., from degradation due to prolonged exposure to direct sunlight.

3.1.10. **Conduit Identification.** Provide conduit with a durable identification labeling showing the name and trademark of the manufacturer, conduit size, date of manufacture and "TxDOT - Fiber Optic Cable System" identification.

3.1.11. **Grounding.** Provide a bare copper No. 8 AWG system grounding conductor, in accordance with Item 620, “Electrical Conductors”, in 1 inner duct of the conduit duct system if no other cable is to be installed in the conduit system for use as a grounding conductor between ground boxes.

3.2. **Outer Duct.**

3.2.1. **PVC Multi-Duct**. Provide heavy walled Schedule 40 polyvinyl chloride (PVC) or heavy walled Schedule 80 PVC outer duct with a nominal inside diameter (ID) of 4 in. as shown on the plans or as directed for underground construction. Provide minimum 20 ft. sections of conduit.

Incorporate a longer integral bell in place of the standard 3-1/2 in. bell to accommodate the length of the coupling body.

Provide 4 in. Schedule 40 conduit with an average outside diameter (OD) of 4.5 in. and a minimum wall thickness of 0.237 in..

Provide 4 in. Schedule 80 conduit, or equivalent with an average OD of 4.75 in. and a minimum wall thickness of 0.337 in. When providing an equivalent to Schedule 80, provide independent laboratory testing certifications showing the equivalent product meets or exceeds performance and testing requirements to that of Schedule 80.

3.2.2. **Rigid Metal Multi-Duct.** Provide galvanized rigid metal conduit (RMC) outer duct with a nominal ID of 4 in. as shown on the plans or as directed. Provide a minimum 10 ft. section of conduit.

Provide 4 in. RMC with an average OD of 4.5 in. and a minimum wall thickness of 0.225 in.

3.2.3. **Fiberglass Multi-Duct.** Provide, bullet resistant, pure, high grade, reinforced thermosetting resin conduit outer duct with a nominal ID of 4 in. as shown on the plans or as directed. Provide a minimum 10 ft. section of conduit.

Provide 4 in. fiberglass conduit with a minimum OD of 4.25 in. and a minimum wall thickness of 0.250 in.

3.3. **Inner ducts.** Provide inner duct Schedule 40 PVC or High Density Polyethylene (HDPE) conduit with a 1.25 in. nominal diameter. Extrude inner ducts in a controlled OD fashion.

3.3.1. **Spacers.** Hold together the inner ducts with spacers located throughout each section of conduit. Factory install the system of spacers to hold inner ducts in place during transport and maintain alignment within the outer duct. Mold spacers from high impact plastic, and be factory certified to withstand all handling pressures and stresses.

3.3.2. **Longitudinal Ribbing.** For HDPE inner ducts, incorporate longitudinal ribbing and permanent dry lubricant that is extruded to provide friction reduction in cable installation.

3.3.3. **Identification by Color.** Provide inner ducts that are uniquely defined by the extrusion of a different color for each of the inner ducts; colors must be orange, yellow, red, and black.

Provide black inner duct that is placed directly in line with the manufacturer's identification on the outer duct for ease of identification and installation.

Duct designated for backbone fiber will be black in color; duct designated for distribution fiber will be orange and red in color; and duct designated for drop (field cabinet) fibers cable will be yellow in color.

3.3.4. **Pull Cord.** Provide a flat pull cord in all empty inner ducts. Provide a pull cord with a tensile strength of 1,250 lb. minimum and have foot markings to determine length installed.

3.4. **Fittings.** Provide fittings with the same material to the connecting conduit unless otherwise shown on the plans.

3.5. **Coupling Body.** Provide a factory installed primary coupling body that is manufactured as a hard plastic coupling body incorporating conical shaped target areas to accommodate self-alignment of each inner duct upon field assembly.

Provide a coupling body that incorporates sealing devices to facilitate field assembly and prevent water and foreign material leakage from outside the multi-duct system and to prevent air leakage from inside the inner ducts. Assemble solely by hand without use of special tools such that no lubricant will be required for field assembly of this conduit system.

Provide the coupling body with its sealing members sealing the outer walls of the inner ducts and the inner wall of the outer duct providing an airtight seal from within the inner duct system and a watertight seal from the outside of the outer duct.

Provide the gasket or sealing members that is an anti-reversing design in such that the lengths of conduit stay joined together without the need for solvent cement.

Provide the field connection end of the internal coupling body that incorporates shaped target areas to accommodate self-alignment of the inner ducts with bore openings during field assembly.

Provide the coupling body that has one of the bore openings on the field assembly side uniquely identified to facilitate proper continuous inner duct alignment during field assembly.

The coupling body must seal the inner duct so that after the application of 100 psi to an inner duct, the inner duct must be capable of maintaining a minimum of 15 psi for 24 hr. Employ an approved independent commercial testing laboratory to perform the above test. Submit certified reports of test to Department.

3.6. **Expansion Joints.** Provide expansion joints having a material similar to the connecting conduit unless otherwise shown on the plans.

Use conduit expansion fittings at structure expansion joint crossings.

3.7. **Termination Kits.** Provide end or pass-through termination kits from the same conduit manufacturer for termination in ground boxes and junction boxes.

Ensure a watertight seal of conduit to structure wall when terminating conduit.

3.8. **Multi-Duct Sweeps.** Conduit deflection should not deviate more than 1 in. horizontally or vertically per foot (1:12) of running length of conduit. Long conduit sweeps should be used wherever possible to change conduit direction in order to reduce the pulling tension required during cable installation.

For conduit deflection at obstructions, utilities, or transitions to structures where the 1:12 deflection requirement above or long sweeps are not possible, use complete conduit manufactured minimum 36 in. radius sweeps (11-1/4º , 22-1/2º, 30º, 45º, and 90º angles) complete with bell and spigot. Do not field bend conduit.

3.9. **Fiber Optic Cable Route Markers.** Furnish tubular delineator markers, minimum 6 ft. in length and a minimum 3 in. OD, and constructed of Type III HDPE material. Provide marker assemblies that are orange in color and ultraviolet stabilized to help prevent components from color fading, warping, absorbing water, and deterioration with prolonged exposure to the elements. Refer to the Standard Details for details of the text on the decal that should be affixed to each marker. Ensure that all markers furnished on this project are new and consistent in appearance.

Install markers using a method that firmly and securely anchors the marker a minimum of 1 ft. into the ground to prohibit twisting and easy removal. When located at an ITS ground box, marker may be placed within the concrete riprap apron avoiding rebar reinforcement. Spacing between markers should not exceed 1,000 ft. or as shown on the plans and placed at significant changes in direction such as a 90º turn. Do not place markers in any roadway paved surface.

4. CONSTRUCTION

4.1. **Underground Construction.** Place conduit in accordance with the lines, grades, details and dimensions shown on the plans or as directed. Maintain constant slope to prevent water from being trapped in the conduit system.

Ream all conduit ends to remove burrs and sharp edges.

Install underground conduit system a minimum of 42 in. from ground surface to the top of the conduit unless otherwise directed or to avoid utility conflicts or field conditions. When conditions require trench depths greater than 5 ft., provide trench protection in accordance with Item 402, “Trench Excavation Protection.” Install conduit in accordance with the requirements of the NEC and USDA RUS.

Fasten all external conduit placed on structures with conduit straps or hangers as shown on the plans or as directed. Conduit straps, hanger systems, and junction boxes are incidental to this Item.

Fit the conduit terminations with bushings or bell ends with duct plugs. Seal inner ducts with duct plugs within 24 hr. of conduit placement. This includes but is not limited to intermediate or incomplete sections of conduit system prior to conduit splicing or termination in ground boxes.

Document Global Positioning System (GPS) coordinate points, in NAD83, and provide to the Department for shifts or deviations of the ITS multi-duct alignment from the plans required to avoid obstructions or utilities. GPS coordinate points to be recorded at the point of curvature and point of tangent for horizontal of vertical transitions and include installed depth.

4.1.1. **Proofing.** Prior to installation of cables or final acceptance, pull a spherical template having a diameter of not less than 75% of the inside diameter of the inner duct through the inner duct to insure that the inner duct is free from obstruction. At the conclusion of proofing, fit ends of all empty inner ducts with duct plugs or caps within 24 hr.

4.2. **Trench Construction.** Provide minimum Schedule 40 PVC conduit when conduit is installed through trenching method unless otherwise shown on the plans or as directed.

Provide a 2 in. minimum layer of sand at the bottom of the trench to serve as a bedding material for construction.

Provide conduit spacers made of a non-metallic material designed for installation underground and encased in concrete. Spacers should be of the type recommended by the conduit manufacturer and designed with an interlocking device and stackable to relive the conduit of both horizontal and vertical stress. Provide spacers sized appropriately for the conduit with a minimum height of 2 in. spaced at 5 ft. intervals throughout the trench. Set conduit spacers directly on the sand bedding. Spacers must be anchored to prevent floating of conduit system and maintain constant slope.

Conduit system will be encased in the following materials based on depth of trench:

4.2.1. **Greater than 24 in.** For trench depths greater than 24 in. from the ground surface to the top of the ITS multi-duct conduit, encase the conduits in flowable fill to an elevation of 6 in. above the top of conduit in accordance with Item 401, “Flowable Backfill,” or ClassB concrete, maximum aggregate size 5, in accordance with Item 421, “Hydraulic Cement Concrete.” Class B concrete at the discretion of the Engineer and will be shown on the plans. Backfill above encasement as defined in Section 4.2.3.

4.2.2. **Less than 24 in.** When a trench depth less than 24 in. is required, encase the conduits in Class B concrete, maximum aggregate size 5, to an elevation of 6 in. above the top of conduit in accordance with Item 421, "Hydraulic Cement Concrete." Backfill above encasement as defined in Section 4.2.3.

4.2.3. **Excavation and Backfill.** Trench, excavate, and backfill as shown on the plans and in accordance with Item 400, "Excavation and Backfill for Structures."

4.2.4. **Marking Tape.** Place a 4 in. wide detectable underground metalized mylar conduit marking tape over the ITS conduit at a minimum depth of 1 ft. below grade when no other electrical marking tape required or 8 in. below electrical marking tape when provisioned under Item 618, "Conduit".

Imprint the marking tape "TxDOT Conduit and Fiber Optic Cable System - Call TxDOT Before Proceeding" every 18 in.

4.2.5. **Restoration of Trench Areas.** Where existing surfacing is removed for placing conduit, repair by backfilling with material equal in composition and density to the surrounding areas and by replacing any removed surfacing, such as asphalt pavement or concrete riprap, with like material to equivalent condition in accordance with Item 400, "Excavation and Backfill for Structures."

4.3. **Boring Construction.** Jacking and boring when required will be in accordance with Item 476, "Jacking, Boring, or Tunneling Pipe or Box"..

When boring under pavement shallower than 48 in. from finish grade to top of conduit, provide Schedule 40 steel casing under pavement to encase the conduit system as shown on the plans unless otherwise directed. Provide steel casing of a size to accommodate all conduits in addition to 20% space capacity for pulling conduits through the steel casing. Steel casing will be furnished in accordance with this Item.

During boring operation, locate bore head every 10 ft. along the bore path and before traversing underground utilities or structures. Use digital walkover locating system to track bore head during boring operation. Ensure locating system is capable of determining pitch, roll, heading, depth, and horizontal position of the bore head and document this information at the intervals specified above for as-built information..

4.4. **Above Ground Construction**. Place conduit in accordance with the lines, grades, details and dimensions shown on the plans or as directed. Maintain constant slope to prevent water from being trapped in the conduit system.

Provide rigid metal conduit or fiberglass conduit for outer duct when system is mounted externally along a bridge or above ground structure. Provide fiberglass or other non-corrosive outer duct for coastal Districts where conduit is exposed to corrosive environments due to salt in the air.

Provide rigid metal conduit outer duct that is hot-dipped galvanized in accordance with Item 445, "Galvanizing."

Ground rigid metal conduit in accordance with the Department's Electrical Details and in accordance with the NEC.

Provide fiberglass conduit that is bullet resistant, heavy walled, pure, high grade, reinforced thermosetting resin conduit.

Provide conduit, elbows, and fittings that are manufactured from the same resin, hardener, or glass systems manufactured by the same filament wound system.

4.5. **Testing.** Perform tests in accordance with industry testing requirements identified in Article 2, "Materials."

4.5.1. **General.** Furnish certified documentation from an independent testing laboratory documenting compliance with all ASTM, NEMA, NEC, UL, and Telcordia Technologies standards as referenced in this Item.

Provide test procedures and blank test forms and conduct performance tests for all materials and equipment not previously tested and approved. If technical data is not considered adequate for approval, samples may be requested for test. The Contract period will not be extended for time lost or delays caused by testing prior to final approval of any items.

Compare the results of each test with the requirements of this Item. Failure to conform to the requirements of any test must be identified as a defect and the materials will be subject to rejection by the Engineer. Offer rejected materials again for retest provided all non-compliances have been corrected and retested by the Contractor with evidence submitted to the Engineer.

4.5.2. **Examination of Product.** Examine each conduit system component prior to installation carefully to verify that the materials, design, construction, markings, and workmanship comply with the requirements of this Item.

4.5.3. **References.** The ITS multi-duct conduit system supplier must submit 3 references, preferably State Departments of Transportation, where this supplier's conduit system has functioned successfully for a period of no less than 1 yr. Include current name and address of organization, and the current name and telephone number of an individual from the organization who can be contacted to verify system installation. Provide this information with documentation submittal. Failure to furnish the above references will be sufficient reason for rejection of the supplier's equipment.

4.6. **Documentation Requirements.** Submit documentation of the conduit system consisting of the following for Engineer approval 30 days prior to installation:

- manufacturer specifications or cut sheets for all components of the conduit duct system,
- laboratory certified material test reports documenting conformance with pertinent standards identified under Article 2, “Materials”,
- GPS coodinates,
- pre-installation test procedures,
- post-installation test procedures, and
- as-built of installed conduit system.

5. MEASUREMENT

ITS multi-duct conduit will be measured by the linear foot of the multi-duct conduit system.

Fiber optic cable road marker will be measured by each maker furnished and installed.

6. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided for under “Measurement” will be paid for at the unit price bid for “ITS Multi-Duct Conduit” of the types and construction method specified. This price is full compensation for furnishing and installing conduit; for jacking, boring, steel encasement, excavating, furnishing, and placing backfill; concrete encasement; replacing pavement structure, sod, riprap, curbs, or other surface; testing of the conduit system; for furnishing and installing all fittings, clamps, sweeps, bends, repair couplings, adapters, ground box or manhole termination kits, pre-assembled split repair kits, lubrication access, fittings, hangers, brackets, junction boxes, expansion joints, concrete, and detectable underground metalized mylar conduit marking tape; pull cords, and for all labor, tools, equipment and incidentals necessary to complete the work.

The work performed and materials furnished in accordance with this Item and measured as provided under “Measurement” will be paid for at the unit price bid for “Fiber Optic Cable Road Marker.” This price is full compensation for furnishing and installing all cable markers; and for materials, equipment, labor, tools, documentation, warranty, training and incidentals.

Copper grounding conductor will be paid under Item 620, “Electrical Conductors.”

This Item applies only to ITS multi-duct conduit. Any other conduit for communication or electrical use will be in accordance with and paid for under Item 618, “Conduit.”

Special Specification 6020
Multipolymer Pavement Markings (MPM) with Warranty

1. DESCRIPTION

Furnish and place MPM as shown on the plans. Provide a manufacturer's warranty bond for longitudinal lines for a 3-yr. period. The Department will allow a Contractor provided warranty bond in lieu of the manufacturer's bond if all conditions of the manufacturer's warranty including the requirements of this Item are met. In such case, the Contractor is responsible for the meeting the warranty requirements. Use the form provided by the Department.

2. MATERIALS

2.1. **Multipolymer Pavement Marking Materials**. Use materials that produce an adherent, retroreflective pavement marking system that meets all of the performance requirements of this Item. Use materials that do not result in the generation of any hazardous materials/wastes, as defined in Article 1.58., "Hazardous Materials or Waste," during application or removal. If requested, provide a laboratory report from a commercial laboratory indicating material used does not result in the generation of any hazardous materials/wastes, as defined in Article 1.58, during application or removal.

Use a multipolymer resin material, which is:

- 2-component (a predominantly multipolymer pigmented resin component with a curing agent component);
- 100% solids, producing no toxic fumes when heated to application temperature;
- track-free in less than 40 min.; and
- formulated and tested to perform as a pavement marking material with glass spheres applied to the surface.

Before work begins, provide a laboratory report from an independent testing laboratory showing that the initial color of each material selected for use conforms to the color limits set forth in Table 1, measured by 45°/0° geometry CIE, D65 Illuminant, 2° standard observation angle in accordance with ASTM E1347, E1348, or E1349.

2.2. **Non-Reflectorized Contrast or Shadow Markings**. The marking material used for the contrast or shadow marking must conform to the same formulation, material, prequalification and sampling requirements with the exception of the following items:

- color pigment used;
- glass spheres must be replaced with a black, color-fast, anti-skid material.

Before work begins, provide a laboratory report from an independent testing laboratory showing that the initial color of each material selected for use conforms to the color limits set forth in Table 1, measured by 45°/0° geometry CIE, D65 Illuminant, 2° standard observation angle in accordance with ASTM E1347, E1348, or E1349.

3. EQUIPMENT

Provide equipment as required or directed according to the following (The provider of the warranty bond is responsible for providing equipment during the warranty period unless otherwise shown on the plans.):

3.1. **Preparation and Application**. Use equipment designed for the pavement preparation and application of the type of MPM material selected.

3.2. **Colorimeter**. Provide a colorimeter using 45°/0° geometry CIE, D65 Illuminant, 2° standard observation angle meeting the requirements of ASTM E1347, E1348, or E1349.

3.3. **Retroreflectometer**. Unless otherwise shown on the plans, provide a portable or mobile retroreflectometer meeting the following requirements.

3.3.1. **Portable Retroreflectometer**. Provide a portable retroreflectometer that meets the requirements of ASTM E1710.

3.3.2. **Mobile Retroreflectometer**. Provide a mobile retroreflectometer that:

- is approved by the Construction Division (CST) and certified by the Texas Transportation Institute Mobile Retroreflectomter Certification Program for project evaluation of retroreflectivity
- is calibrated daily, before measuring retroreflectivity on any pavement stripe, with a portable retroreflectometer meeting the following requirements: ASTM E1710, entrance angle of 88.76°, observation angle of 1.05°, and an accuracy of ±15%
- requires no traffic control when retroreflectivity measurements are taken and is capable of taking continuous readings at posted speeds

Furnish mobile retroreflectivity measurements in compliance with Special Specification Mobile Retroreflectivity Data Collection for Pavement Markings unless otherwise approved by the Engineer. The Engineer may require an occasional field comparison check with a portable retroreflectometer meeting the requirements listed above to insure accuracy.

4. CONSTRUCTION

4.1. **General**. Prepare the pavement surface using controlled techniques that minimize pavement damage and hazards to the traveling public. Apply the MPM materials, according to the manufacturer's recommendations, using widths, colors, shapes, and at locations as shown on the plans.

Obtain approval for the sequence of work and estimated daily production. Use traffic control as shown on the plans or as approved. Establish guides to mark the lateral location of pavement markings as shown on the plans or as directed, and have guide locations verified. Use material for guides that will not leave a permanent mark on the roadway. Apply markings in alignment with the guides and without deviating for the alignment more than 1 in. per 200 ft. of roadway or more than 2 in. maximum. Remove all applied markings that are not in alignment or sequence as stated in the plans or as stated in the specifications at the Contractor's expense and in accordance with Item 677, "Eliminating Existing Pavement Markings and Markers," except for measurement and payment.

4.2. **Initial Performance Requirements**. Meet Article 5, "Performance Requirements," initially, after installation. Perform an initial performance evaluation after 7 and before 15 days after MPM are installed to verify that the MPM meet the performance requirements in Article 5 for retroreflectivity. Conduct initial retroreflectivity evaluations of placed pavement markings with either a portable or mobile retroreflectometer, unless otherwise shown on the plans, according to Section 5.4.2., "Retroreflectivity." The Contractor is responsible for traffic control when conducting performance evaluations.

For color and durability, the Engineer will conduct a visual evaluation and require Contractor testing only if MPM do not appear to meet the performance requirements in Article 5.

For MPM not meeting performance requirements, repair or replace until reevaluation shows the MPM meet the performance requirements as approved by the Engineer.

4.3. **Written Acceptance**. The Department will provide written acceptance after the Contractor meets the initial performance requirements. This written acceptance (see attached sample form) will include the date, location, length, and type of MPM.

5. PERFORMANCE REQUIREMENTS

5.1. **Color**. Provide MPM consisting of pigments blended to provide color conforming to standard highway colors as shown in Table 1.

Table 1
Color Requirements

Federal 595 Color		Chromaticity Coordinates								Brightness (Y)
		1		2		3		4		
		x	y	x	y	x	y	x	y	
White	17855	.290	.315	.310	.295	.350	.340	.330	.360	60 min
Yellow	33538	.470	.455	.510	.489	.490	.432	.537	.462	30 min
Black										5 max

5.2. **Retroreflectivity**. Provide MPM meeting the minimum retroreflectivity values listed in Table 2.

Table 2
Minimum Retroreflectivity Requirements

Color	Retroreflectivity, mcd/m^2/lx, Min
White	175
Yellow	125

5.3. **Durability**. Provide MPM that do not lose more than 5% of the striping material in a 1,000- ft. section of continuous stripe or broken stripe (25 broken stripes). Pavement markings must remain in the proper alignment and location.

5.4. **Performance Evaluation Procedures**. Provide traffic control and conduct evaluations of color, retroreflectivity, and durability as required or directed.

5.4.1. **Color**. Measure color using 45°/0° geometry CIE, D65 Illuminant, 2° standard observation angle in accordance with ASTM E1347, E1348, or E1349.

5.4.2. **Retroreflectivity**. Unless otherwise shown on the plans, conduct retroreflectivity evaluations of pavement markings with either a portable or mobile retroreflectometer. Make all measurements in the direction of traffic flow, except for broken centerline on 2-way roadways, where measurements will be made in both directions.

If using a portable retroreflectometer, take a minimum of one measurement every mile on each series of markings (i.e., edgeline, center skipline, each line of a double line, etc.), at approved locations. If more than one measurement is taken, average the measurements. For all markings measured in both directions, take a minimum of one measurement in each direction. If the measurement taken on a specific series of markings within each mile segment falls below the minimum retroreflectivity values, take a minimum of 5 more measurements within that mile segment for that series of marking. If the average of these 5 measurements falls below the minimum retroreflectivity requirements, that mile segment of the applied markings does not meet the performance requirement.

If using a mobile retroreflectometer, review the results to determine deficient sections and deficient areas of interest. These areas do not meet the performance requirements.

5.4.3. **Durability**. Measure durability in accordance with ASTM D913 for marking material loss and visual inspection for alignment and location. Conduct evaluations at locations approved by the Engineer.

6. WARRANTY REQUIREMENTS

The warranty requirements apply to the longitudinal lines only. Transverse and gore markings, symbols, words, etc. will not require warranty.

Each warranty period is for 3 yr. and starts the day after written acceptance.

The warrantor is responsible for meeting Article 5, “Performance Requirements,” for the duration of the warranty period.

During the warranty period, the Engineer will conduct periodic visual performance evaluations of MPM. For retroreflectivity, the Engineer will use Tex-828-B, “Determining Functional Characteristics of Pavement Markings.” The warrantor may be present during these evaluations. For areas, which, in the opinion of the Engineer, have a questionable visual evaluation, the warrantor may replace the MPM or may conduct a performance evaluation for the performance requirement in question, according to Section 5.D, “Performance Evaluation Procedures.” Conduct retroreflectivity evaluations according to Section 5.D.2, “Retroreflectivity,” using either portable or mobile retroreflectometer unless otherwise shown on the plans. The warrantor is responsible for traffic control when conducting performance evaluations.

The warrantor will replace MPM that fails to meet the color, retroreflectivity, or durability performance requirements during the warranty period. Within 15 days after notification place new markings in accordance with Article 4, “Construction.”

All replacement MPM must meet the materials and performance requirements of this specification.

The end of the warranty period does not relieve the warrantor from the performance deficiencies requiring corrective action identified during the warranty period.

The Engineer may exclude MPM from the replacement provisions of the warranty period, provided the Engineer determines that the failure is a result of outside causes rather than defective material. Examples of outside causes are extreme wear at intersections, damage by snow or ice removal, and premature pavement failure.

Provide a contact name, address and telephone number for notification of needed MPM replacement.

7. MEASUREMENT

This Item will be measured by the foot; by each word, symbol, or shape; or by any other unit shown on the plans. Each stripe will be measured separately.

This is a plans quantity measurement Item. The quantity to be paid is the quantity shown in the proposal unless modified by Article 9.2., “Plans Quantity Measurement.” Additional measurements or calculations will be made if adjustments of quantities are required.

8. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under “Measurement” will be paid for at the unit price bid for “Multipolymer Pavement Markings (MPM) with Warranty” of the type and color specified and the shape, width, and size specified as applicable, at the time of project acceptance. This price is full compensation for materials, application of MPM, equipment, labor, tools, and incidentals.

MPM INSTALLATION RECORD FOR WRITTEN ACCEPTANCE

** Warranty period begins the day after written acceptance.

COUNTY HIGHWAY	CONTROL PROJECT	LIMITS FROM LIMITS TO	LENGTH	TYPE MPM	ACCEPTANCE DATE

Contractor signature _____ _____
Date

Department signature _____ _____
Date

WARRANTY BOND		CONTRACT NO.	
		COUNTY	
		BOND NO	

KNOW ALL PERSONS BY THESE PRESENTS: That we, _ _____, manufacturer of or Contractor for multipolymer pavement markings, as Principal, and _ _____, as Surety, are held and firmly bound unto the State of Texas, as Obligee, in the penal sum of _ _____Dollars **$**_ _____, lawful money of the United States, well and truly to be paid to the State of Texas, and we bind ourselves, our heirs, successors, executors, and administrators jointly and severally, firmly by these presents.

Whereas, the above bounden Principal has provided multipolymer pavement markings to _ _____for the foregoing contract entered into between _ _____ and the Obligee, attached hereto; and

Whereas, the Principal is required to protect the Obligee against any defects resulting from faulty multipolymer pavement markings installed under said contract for a period of 3 years beginning the day after written acceptance.

Now, therefore, the condition of this obligation is such that if the above bounden principal, its heirs, successors, executors, and administrators shall promptly and faithfully carry out and perform the warranty as provided in said contract, and shall, within fifteen days of due notice, replace any installed multipolymer pavement markings that may fail to meet Obligee's performance evaluation as provided for in the Contract during the period specified above or shall pay over, make good, and reimburse to the said Obligee all loss and damage that said Obligee may sustain by reason of failure or default of said Principal so to do, then this obligation shall be null and void, otherwise it shall remain in full force and effect.

Provided further that the end of a warranty period shall not relieve Principal from its obligation to correct deficiencies requiring corrective action, so long as those deficiencies are identified during the warranty period.

WITNESS our hand this _____ day of _____ 20 _____.

_____
(Warrantor Name)

_____ * By: _____
****SURETY** (Print Firm Name and Seal) (Warrantor Officer)

By: _____ * By: _____
(Title) (Warrantor Officer)

_____ _____
****SURETY** (Print Firm Name and Seal) ****SURETY** (Print Firm Name and Seal)

By: _____ By: _____
(Title) (Title)

Note: * Attach a Power of Attorney showing that the officer of the warrantor has authority to sign this obligation.

** Attach a Power of Attorney showing that the surety officer or Attorney-In-Fact has authority to sign this obligation; the Power of Attorney and bond must be impressed with the corporate seal. The surety must be a US Treasury listed company and provide notification information.

Special Specification 6027

Preparation of Existing Conduits, Ground Boxes, or Manholes

1. DESCRIPTION

Prepare conduits, ground boxes, or manholes; replace conduits, ground boxes, or manholes, when necessary; replace conduit fittings with junction boxes; replace damaged ground box or manholes covers; adjust ground box or manholes covers; install pull lines in conduits; install cable racks in ground boxes or manholes.

2. MATERIALS

Provide new materials that comply with the details shown on the plans, the requirements of this Item, and to the pertinent requirements of the following Items:

- Item 624, “Ground Boxes”
- Item 465, “Manholes and Inlets”

When conduit replacement is required, provide conduit meeting the requirements of Item 618, “Conduit.” Use conduit of same size and type of that being replaced or as directed.

Provide 24 in. × 24 in. × 12 in. (L × W × D) minimum size NEMA 4X junction boxes with screw covers.

Provide polyester tapes or rope pull cords with a tensile strength of at least 1200 lb.

Provide heavy duty, non-metallic, non-corrosive cable racks that can support a minimum dead load of 300 lbs. Ensure cable racks are resistant to the effects of oils, hydrocarbons, common esters, ketones, ethers, or amides. Ensure cable racks are adjustable between 8 in. and 14 in. wide. Do not provide grounding or insulators for cable racks.

3. CONSTRUCTION

Check existing conduit and ground boxes.

3.1. **Preparation of Conduit, Ground Box or Manhole**. Pull a mandrel through empty conduits. Use a mandrel with a diameter greater than 70% of the inside diameter of the conduit and 2 in. length. Repair or replace conduit runs that will not allow passage of the mandrel. Replace conduit deemed impractical to repair or remains unsuitable in accordance with Item 618, “Conduit.” Clean the conduit by pulling a rubber swab slightly larger in diameter than the conduit.

Blow compressed air through conduits that contain wires. Remove debris from the conduit by pushing a fish tape through the conduit. Do not use water to clear debris. Retest the conduit by blowing compressed air.

Install 1 pull cord in each conduit for use in installing the conductors, cables, or innerduct. Leave 1 pull cord in each conduit after the conductors, cables, or innerduct have been installed.

Remove silt and debris from ground boxes or manholes prior to installing cable.

3.2. **Installation of Ground Box or Manhole**. Furnish new ground boxes or manholes as directed. Install ground boxes or manholes as shown the plans or as directed.

Backfill disturbed surface with material equal in composition and density to the surrounding area. Replace surfacing material with similar material to an equivalent condition.

3.3. **Installation or Adjustment of Ground Box or Manhole Covers**. Remove, dispose, and install ground box or manhole covers as shown on the plans or as directed. Adjust ground box or manhole covers as shown on the plans or as directed. Adjustment may include welding, raising, or lowering.

Backfill disturbed surface with material equal in composition and density to the surrounding area. Replace surfacing material with similar material to an equivalent condition.

3.4. **Installation of Junction Box**. Locate conduit fittings in conduits carrying fiber optic cables. Replace the conduit fitting and associated section of conduit with a junction box. Install junction boxes as shown on the plans.

3.5. **Installation of Cable Rack Assembly**. Install cable racks to permit coiling of conductors or cables without violating the manufacturer's minimum bending radius. Install 2 cable rack supports and 4 adjustable levels on each support, at a minimum, on each wall of the ground box or manhole as shown on plans or as directed. Anchor the cable rack support permanently to the ground box wall with mechanical or powder actuated fasteners. Use fasteners with an ultimate pull out strength of at least 2500 lb. and ultimate shear strength of at least 3000 lb. Provide sufficient cable supports for the particular number of conductors or cables coiled or passing through the ground box or manhole as shown on the plans or as directed.

4. MEASUREMENT

This Item will be measured by the foot of conduit cleared, tested, replaced and repaired, by each cable rack, junction box, ground box, or manhole installed or prepared, and by each ground box or manhole cover replaced or adjusted.

5. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under “Measurement” will be paid for at the unit price bid for “Conduit (Prepare),” “Junction Box (Install),” “Manhole (Install),” “Ground Box (Install),” “Manhole (Prepare),” “Ground Box (Prepare),” “Cover (Replace)” of the sizes specified, “Cover (Adjust),” and “Cable Rack Assembly (Install).” This price is full compensation for cleaning and testing conduit, ground boxes, and manholes; furnishing and installing pull cords, ground boxes, manholes, junction boxes, and cable racks; excavating and backfilling; adjusting ground boxes and manholes covers; disposal of unsalvageable material; and equipment, materials, labor, tools, and incidentals.

Repair of existing conduit will be paid for by the Department in accordance with Article 9.7., “Payment for Extra Work and Force Account Method.”

Special Specification 6032
ITS System Integration

1. DESCRIPTION

This Item shall govern for the integration of all furnished equipment and software as shown on the plans, as detailed in this Special Specification, and as directed. Furnish, install, test, and integrate all hardware and software into the existing traffic management center.

2. SYSTEM EQUIPMENT AND INSTALLATION

Install, interconnect, test, integrate, and make fully operational all equipment and the system in accordance with the National Electrical Code (NEC).

Select, install, and integrate the equipment and software as required to achieve a complete and fully operational system as shown on the plans, as detailed in this Special Specification, and as directed.

3. SYSTEM INTEGRATION

Provide an end-to-end communication system for integration into the traffic management center. Equipment includes, but is not limited to:

- CCTV equipment (when shown on plans)
- DMS equipment (when shown on plans)
- RVSD equipment (when shown on plans)
- LCS equipment (when shown on plans)
- VIVDS equipment (when shown on plans)

Provide, install, and make operational a complete and functional system. Install and integrate all field, central, and communications components. Items not specifically mentioned or addressed in this specification necessary for a complete and operational system as described herein shall be provided by the Contractor and shall not be paid for directly but shall be considered incidental to this Item.

Perform work inside existing enclosures, when required, including re-routing, re-assignment re-wiring, reconfiguration, re-switching, and re-cabling, based on the proposed configuration as shown in the plans and as detailed in the specifications. Perform all work in accordance with the plans. Peform all necessary work to achieve a fully functional and operational system, including all re-routing, terminations, connections, splicing, and re-assignments.

4. TESTING, TRAINING, DOCUMENTATION, FINAL ACCEPTANCE AND WARRANTY

All testing, training, documentation, final acceptance and warranty requirements will be in accordance with Special Specification, “Testing, Training, Documentation, Final Acceptance, and Warranty.”

5. MEASUREMENT

This item will be measured by the lump sum.

6. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "System Integration." This price shall be full compensation for preparing, furnishing, and installing all materials, equipment, and incidentals.

Special Specification 6049
Longitudinal Channelizing Mountable Curb System

1. DESCRIPTION

Furnish and install, relocate, or remove longitudinal channelizing mountable curb systems, which includes curb sections and curb system delineator posts.

2. MATERIALS

Provide new longitudinal channelizing mountable curb systems manufactured by one of the approved vendors from the Department's MPL.

Provide longitudinal channelizing mountable curb systems the color as detailed in the plans.

After delivery, a construction site inspection of the longitudinal channelizing curb system and equipment will be made by the Engineer.

If any section of the longitudinal channelizing mountable curb system has been damaged or if, for any reason, the component does not comply with the requirements herein, the Contractor shall repair or replace the longitudinal channelizing mountable curb system at their expense.

Once approved by the Engineer, the longitudinal channelizing mountable curb system shall be installed.

3. CONSTRUCTION

3.1. **Install**. Install the longitudinal channelizing mountable curb system in the location as shown on the plans. Follow manufacturer's installation procedures regarding anchoring systems into the various types of roadway surfaces. Only use anchors and hardware provided by the manufacturer. Remove any conflicting pavement markings and raised pavement markers in the locations where the longitudinal channelizing mountable curb system is to be installed.

3.2. **Relocate**. Relocate longitudinal channelizing mountable curb system in accordance with the details shown on the plans.

3.3. **Removal**. Remove existing longitudinal channelizing mountable curb system as shown on the plans. Deliver the curb system and installation hardware such as mounting anchors to the Department at designated location.

4. MEASUREMENT

Longitudinal channelizing mountable curb systems installed, relocated or removed will be measured by the linear foot of curb system.

5. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit bid price for "Longitudinal Channelizing Mountable Curb System" of the work category (Install, Relocate, or Remove). This price is full compensation for all equipment, labor, tools, materials, and incidentals.

5.1. **Furnish and Install**. This price is full compensation for furnishing and installing curb system.

5.2. **Relocate**. This price is full compensation for moving the curb system installations on the project from one location to another (including disassembly and reassembly costs).

5.3. **Remove**. This price is full compensation for removing curb system and installation hardware from the project and delivering to the Department stockpile as shown on the plans or as directed by the Engineer.

Special Specification 6053
Shifting or Removing Existing Overhead Signs

1. DESCRIPTION

Shift or remove existing overhead sign panels.

2. MATERIALS

Reuse existing sign panel materials as shown on the plans. When required, provide new materials that comply with the details shown on the plans, the requirements of this Item, and the pertinent requirements of the following:

- Item 636, "Signs"
- Item 654, "Sign Walkways"

3. CONSTRUCTION

Shift or remove signs on structures as shown on the plans or as directed. Remove and store shifted signs as necessary. Prevent damage to sign components. Reuse existing attachment hardware as directed. Cut sign support brackets, if necessary; however, do not extend or lengthen existing brackets. Furnish additional sign attachment hardware, support brackets, etc., as directed. Adjust or add support brackets and appurtenances such as sign lights, walkways, conduit, etc., as shown on the plans.

Handle and store signs to prevent damage to sign corners, edges, and faces. Store signs off the ground and in a vertical position. Store signs 60 in. × 60 in. or smaller in a weatherproof building. Larger signs may be stored outside. Damage to the sign face that is not visible when viewed at a distance of 50 ft., night or day, will be acceptable. Replace unacceptable signs and components.

Stockpile removed sign components for reuse or that become property of the Department at a designated locations. Accept ownership of unsalvageable materials and dispose of in accordance with federal, state, and local regulations.

After installation, wash signs with a biodegradable cleaning solution acceptable to the manufacturers of the sheeting, colored transparent film, and screen ink to remove grease, oil, dirt, smears, streaks, finger marks, and other foreign material.

4. MEASUREMENT

This Item will be measured by each sign panel shifted or removed.

5. PAYMENT

The work performed and materials furnished as accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Shift Overhead Sign Panels" or "Remove Overhead Sign Panels." This price is full compensation for shifting, reinstalling, or removing the existing sign panels; furnishing and installing new mounting hardware; furnishing and installing new sign panels, when required; cleaning sign panels; storing of components to be reused or salvaged; disposal of unsalvageable material; and equipment, labor, tools, and incidentals.

Special Specification 6058
Battery Back-Up System for Signal Cabinets

1. DESCRIPTION

Install a Battery Back-Up System (BBU System) for traffic signals that will provide reliable emergency power in the event of utility power failure or interruption. The system will also function as a power conditioner and/or voltage regulation device.

A BBU System consists of inverter/charger, manual bypass switch, power transfer switch or automatic bypass switch, batteries, battery monitoring device, wiring, external cabinet or stand-alone cabinet, concrete pad, all necessary hardware and software, and all associated equipment required to operate in a field environment.

The BBU System shall be capable of operating an "LED only" signalized intersection (700W load) for 4 hours of full runtime when utility power is disabled and under ambient temperatures of 25oC. The BBU System shall switch the intersection to flash mode of operation when approximately 40% of battery charge is remaining, via relay contact connection points on the front panel of the unit. The BBU system shall operate the intersection in the flash mode of operation (300W load) for an additional 2 hours. BBU system components shall be rated for a minimum 1400W load capacity.

The BBU shall be designed for outdoor applications in accordance with NEMA TS2-2003, Section 2. All components of the BBU system shall be rated to operate under temperature extremes of -34oC to +74oC.

2. DEFINITIONS

2.1. **Automatic Bypass Switch**. A unit connected between the utility power supply and the inverter/charger which can automatically switch power to the controller cabinet service panel from inverter output power to utility line power.

2.2. **Battery Back-Up System (BBU System).** The battery back-us system includes, but is not limited to, a manual bypass switch, automatic bypass switch or power transfer switch, inverter/charger, batteries, battery monitoring device, wiring, external cabinet and all necessary hardware for system operation.

2.3. **Battery Back-Up System Software.** All software associated with operation, programming and functional requirements of the BBU system.

2.4. **Battery Monitoring Device.** The device which monitors battery temperatures and charge rate of the batteries used in the BBU system.

2.5. **Batteries.** Standard 12V batteries wired in series to create a 36VDC to 96VDC voltage storage.

2.6. **Boost.** When enabled, the BBU inverter/charger shall automatically switch into this mode to raise the utility line voltage when it drops below a preset limit. The limit may be user defined or use manufacturer default settings (typically 100V AC).

2.7. **Buck.** When enabled, the unit shall automatically switch into this mode to reduce the utility line voltage when it rises above a preset limit. The limit may be user defined or use manufacturer default settings (typically 135V AC).

2.8. **External or Stand-Alone Cabinet.** The structure which houses the system components and/or batteries for the BBU System.

2.9. **Inverter/Charger.** The unit which converts the DC voltage input into 120 VAC output for the traffic signal cabinet to operate. As a minimum the inverter/charger shall be rated for 1400 watts.

2.10. **Inverter Line Voltage.** The power supplied from the BBU system to the traffic signal cabinet from the BBU System inverter.

2.11. **Manual Bypass.** Manual switch that allows user to bypass BBU power to service system equipment. Manual bypass switch switches utility line power directly to cabinet.

2.12. **Power Transfer Switch.** A unit connected between the utility power supply and the inverter/charger which can automatically switch from utility line power to inverter output power. The power transfer relay may be a separate unit or combined with the manual bypass switch. In the event of battery voltage loss, the power transfer switch will automatically return to utility line power.

2.13. **Signal Operation Mode.** A signalized intersection generating a 700W load when running in normal operation.

2.14. **Signal Flash Mode.** A signalized intersection generating a 300W load when running in the flash mode of operation.

2.15. **Utility Line Voltage.** The 120V AC power supplied to the BBU system.

3. EQUIPMENT

Ensure electrical materials and construction methods conform to the current NEC and additional local utility requirements. Furnish battery back-up systems prequalified by the Department. The Traffic Operations Division maintains a Material Producer List (MPL) of prequalified battery back-up systems. Ensure all materials and construction methods conform to the details shown on the plans, the requirements of this Item, and the pertinent requirements of the following Items:

- Item 420, “Concrete Substructures”
- Item 620, “Electrical Conductors”

Provide and install a BBU system that is able to fulfill the following requirements:

3.1. **Method of Operation.** The BBU system shall operate using one or more of the following methods:

3.1.1. **Buck and Boost Method**. When the buck and boost functions are enabled they shall set the upper and lower control limit allowable for the utility line voltage.

If the utility line voltage fluctuates above or below the buck and boost values, the BBU system shall raise or lower the voltage by approximately 10-15% of the utility line voltage in an attempt to bring the voltage back into the upper and lower control limits. Buck and boost shall have preset manufacturer defaults.

If the utility line voltage falls above or below the functional capabilities of buck and boost, then the BBU system will transfer power from the utility line voltage to the inverter line voltage.

3.1.2. **Stand-by Method.** The stand-by method shall set upper and lower control limits for the utility line power. If the utility line voltage falls above or below the upper or lower control limits, then the BBU system will transfer power from the utility line voltage to the inverter line voltage.

3.1.3. **Continuous Operating Mode, Double Conversion Method.** The continuous method supplies the cabinet with inverter line voltage at all times. This method requires the disabling of buck and boost functions.

3.2. **System Capabilities.** The BBU system shall be capable of providing 1400W peak load, with a minimum of 80% inverter efficiency, for at least 10 seconds.

The BBU system shall be capable of providing 700W signal operation load for a minimum of 4 hours, and then switching to and providing 300W signal flash load for an additional 2 hours minimum, when batteries are fully charged.

When the BBU system is running on battery power, the inverter/charger shall be capable of allowing the voltage at which the transition from normal operating load to flash mode occurs (usually 47.5V) to be selected by a user, via relay contacts and connection points on the front panel of the inverter/charger.

The transfer time allowed, from disruption of normal utility line voltage to stabilized inverter line voltage from batteries, shall be less than 65 milliseconds. The same allowable transfer time shall also apply when switching from inverter line voltage to utility line voltage.

The BBU system shall bypass utility line voltage whenever the utility line voltage is outside of the manufacturer's default, or a user-programmed voltage range, ±2VAC.

When the utility line power has been restored to a normal operating voltage for more than a user defined setting (default 30 seconds), the BBU system shall transfer from inverter line voltage to utility line voltage. The BBU system shall be equipped to prevent a malfunction feedback to the cabinet or from feeding back to the utility service.

The BBU system shall be compatible with TS1, TS2 and Model 170/2070 controllers and cabinet components for full run-time operation.

Unless the plans indicate otherwise, provide a BBU in an external battery cabinet. When indicated by the plans, provide a BBU system that can be shelf-mounted in NEMA TS-1 and TS-2 cabinets, or rack-mounted for Model 170/2070 332 cabinets. Provide a manual bypass that is capable of shelf mounting or that can be attached to the side of the signal cabinet. Provide interconnect cables that are no less than 10 ft. in length.

Relay contact wiring for each set of NO/NC relay contact closure terminals shall be no less than 6 feet long and #18 AWG wire. Use manufacturer recommendations for size of wire for any cables lengths greater than 10 feet.

The BBU system shall have lightning surge protection compliant with IEEE/ANSI C.62.41 latest edition and meeting all current UL1449 standards. Lightning surge protection shall be provided to the utility line voltage coming into the inverter/charger. The surge protection device shall be easily accessible and mounted externally from the inverter/charger.

The BBU system, including batteries and hardware, shall be easily replaceable and shall not require any special tools for installation.

The BBU system shall operate in automatic "fail-safe" mode. Should a breaker trip on the inverter/charger and/or the power transfer switch, the system will automatically operate from utility line power and bypass the BBU system.

As stated above, in addition to the inverter/charger, the BBU shall be provided with both an external manual bypass switch and either an external automatic transfer switch or external automatic bypass switch.

The BBU system shall be capable of logging up to 100 events. Events shall date- and time-stamp faults with utility line voltage and battery voltages. At the minimum, the BBU system shall log an event when:

- the utility line voltage falls above or below the upper or lower control limits,
- the BBU system automatically switches to battery power, and
- when self-monitoring BBU system components fail.

3.3. **Displays, Controls, Diagnostics and Maintenance.** The BBU system shall include a front panel display. All applicable programmable functions of the operational methods described in this specification shall be viewable from the front panel display.

All events described in Section 3.2, "System Capabilities" shall be viewable from the front panel display.

The BBU system software shall be programmable from the front panel of the inverter/charger by means of a keyboard or momentary buttons allowing user to step through menu driven software.

A 10/100 Ethernet port shall be provided on the front panel of the inverter/charger.

A RS232 port shall be provided on the front panel of the inverter/charger.

The BBU system software shall be provided for the operational needs of the BBU system. The user/operator shall be able to access all system software via the Ethernet and RS232 ports on the front panel of the inverter/charger. The user shall be able to read logged events and change programmable parameters from the keyboard, laptop or local area network via the Ethernet port.

System software shall be upgradeable via the RS232 port on the front panel of the inverter/charger.

3.4. **Inverter/Charger.** The inverter/charger is the unit that provides the voltage regulation; power conditioning of utility line power; convert the DC voltage input into 120 VAC output for the traffic signal cabinet to operate; provides emergency backup power upon loss of utility power and provides for temperature compensated battery charging. As a minimum the inverter/charger shall be rated for 1400 watts. Provide a minimum of 6 sets of normally open (NO) and normally closed (NC) single-pole double-throw dry contact relay closures on the front face of the inverter/charger and labeled so as to identify each contact. The relay closures shall consist a set of NO/NC contact closures that shall be energized whenever the unit switches to battery power (contact shall be labeled or marked as “On Battery” or equivalent) and a second set of NO/NC contact closures shall be energized whenever the battery approaches 40% remaining capacity (contact shall be labeled or marked as “Low battery” or equivalent”), which will determine when the unit will switch from normal operation to flash. A third set of NO/NC contact closures shall be energized after a user settable time after the unit switches to battery power. The contact may be labeled “Timer. The remaining relays shall be user definable.

Operating temperature range for both the inverter/charger and power transfer relay shall be -34°C to +74°C. When battery power is used, the BBU system output voltage shall be between 110VAC and 125VAC, pure sine wave output, ≤ 3% THD, 60Hz ± 3Hz.

3.5. **Manual Bypass Switch.** The manual bypass switch shall be provided as a separate unit external to the inverter/charger unit. The manual bypass switch shall consist of housing, two position switch, terminal blocks, internal wiring, service outlet, circuit breakers and mounting hardware. All components shall be rated at a minimum of 240VAC / 30 amp. Provide the manual bypass switch with # 8 terminal blocks. The manual bypass switch shall be 2 position and allow the user to switch utility line power directly to the cabinet service panel. The switch positions will provide the following functions. In the “Bypass” position the inverter is bypassed, utility power is removed from the BBU and passed directly to the signal power panel. In the “UPS” position the inverter / switch is powered and the signal circuits are supplied by the output of the inverter. When the manual bypass switch is in the “Bypass” position the user may replace the automatic bypass switch (or transfer switch) and the inverter/charger without interrupting power to the intersection. Provide the manual bypass switch with over current protection (20 Amp circuit breaker).

3.6. **Power Transfer Switch.** These requirements are for BBU systems provided with a power transfer switch. The power transfer switch will operate such that the inverter/charger input and cabinet power panel are supplied with power from the utility line, in the event that the utility line power is lost or requires conditioning (buck or boost) the power transfer switch will automatically connect the inverter/charger output to the cabinet power panel such that the inverter/charger output provides the power. In the event of inverter/charger failure, battery failure, or complete battery discharge, the power transfer shall revert to the NC (de-energized) state, where utility line power is connected to the cabinet service panel.

All wire to the power transfer switch from the manual bypass switch, to and from the inverter/ charger and from the manual bypass switch to utility power service shall be sized accordingly with system requirements.

3.7. **Automatic Bypass Switch.** These requirements are for BBU systems provided with an automatic bypass switch. The automatic bypass switch will operate such that the inverter/charger input is supplied with power

from the utility line and the cabinet power panel is supplied with power from the output of the inverter/charger. In the event of inverter/charger failure, battery failure, or complete battery discharge, or other loss of power from the output of the inverter/charger, the automatic bypass switch shall revert to the NC (de-energized) state, where utility line power is connected to the cabinet service panel.

3.8. **Batteries.** Provide batteries from the same manufacturer/vendor of the BBU system.

Individual batteries shall be 12V type, and shall be easily replaceable and commonly available for purchase by common off-the-shelf equivalent.

Batteries shall be sized and rated to operate a 700W load for 4 hours (normal operation) followed by a 300W load for 2 hours (flash operation) for a total of 6 hours.

Battery configuration shall consist of 12V batteries arranged for total voltages of 36V, 48V, 60V, 72V, 84V or 96V.

Batteries shall be deep-discharge, sealed prismatic lead-calcium based, valve-regulated maintenance-free batteries.

Batteries shall operate over a temperature range of -34°C to +74°C.

Batteries shall indicate maximum recharge data and recharging cycles, and manufacturer defaults on the inverter/charger shall not allow the recharging process to exceed the batteries maximum values.

Battery interconnect wiring shall connect to the inverter unit via modular harness with red and black cabling that terminates into a typical power pole style connector. Harness shall be equipped with mating power flag style connectors for batteries and a single insulated plug-in style connection to inverter/charger unit. Harness shall allow batteries to be quickly and easily connected in any order and shall be keyed to ensure proper polarity and circuit configuration. A fusible link or device sized accordingly with system requirements and to protect against currents exceeding each battery current rating shall be provided within 3 inches of the negative and positive leads of each battery. Fusible links shall be insulated stranded wire.

Insulated covers shall be provided at the connection points (post) as to prevent accidental shorting.

Battery cables provided to connect battery to battery harness main cable shall be a minimum of 18 in. or long enough to accommodate the battery covers provided with the battery ground box, whichever is longer. Battery harness shall be sized accordingly with system requirements.

3.9. **Battery Monitoring System.** The BBU system shall use a temperature-compensated battery charging system. The charging system shall compensate over a range of 2.5 – 4.0 mV/°C per cell.

The temperature sensor shall be used to monitor the temperature and regulate the charge rate of the batteries. Unless required otherwise by the plans the temperature sensor wire shall be as follows:

- 8 feet long if external side-mounted cabinet is attached to existing controller cabinet.
- 8 feet long if batteries are housed in traffic signal base used for cabinet foundation and batteries are stored on shelf within base.
- 8 feet long if stand-alone cabinet is used.

Should the temperature sensor fail, the inverter/charger shall not allow the BBU system to overcharge the batteries. The BBU system shall provide an alarm should the temperature sensor fail.

Recharge time for the batteries to obtain 80% or more of full battery charge capacity shall not exceed 20 hours at 21°C (70°F).

Batteries shall not be charged when battery temperature exceeds 50°C.

The BBU system shall monitor battery strings within a system and set a fault indicator if battery voltage falls below normal operating voltage.

3.10. **Battery Housing.** Unless plans require otherwise, project an external battery cabinet or stand-alone BBU/battery cabinet as specified below.

3.10.1. **External Battery Cabinet.** The external cabinet shall be NEMA type 3R all-aluminum with stainless-steel hardware, or approved equivalent. The external cabinet shall be designed to attach on the side of a TS2 size 6 base-mount cabinet. The batteries, inverter, transfer switches, manual bypass and all associated hardware shall be housed in the external cabinet.

The external cabinet shall be equipped with proper ventilation, electric fan, and air filter in accordance with TS2 standards.

External cabinets will be equipped with a door opening to the entire cabinet. The door shall be attached to the cabinet with a full length stainless steel piano hinge or four, two-bolts per leaf, hinges. The door shall be provided with the same latch and lock mechanism as required for standard traffic signal cabinet. In addition, a padlock clasp will be provided.

When using battery ground boxes, an external cabinet is required for the non-battery components. .

3.10.2. **Stand-Alone BBU/Battery Cabinet.** When required for installation by the plans a stand-alone cabinet in accordance with the following shall be provided.

The stand-alone cabinet shall conform to all the specifications of the External BBU/Battery Cabinet, except that it will not mount to the controller cabinet. The stand-alone cabinet shall be designed to attach to a concrete pad.

3.11. **Concrete Pad.** Provide a Class B concrete pad as a foundation for stand-alone cabinets of the size shown in the plans. For external cabinets, extend the controller foundation to provide a class B concrete pad under the external cabinet of the size shown in the plans.

3.12. **Documentation.** Operation and maintenance manuals shall be provided. The operation manual shall include a block diagram schematic of all system hardware components. The manual shall include instructions for programming and viewing software features. The manual shall include all uploading/downloading (communications protocol) requirements via RS232 or Ethernet port.

Board level schematics shall be provided when requested.

Battery documentation and replacement information shall be provided.

3.13. **Testing.** The Department reserves the right to do testing on BBU systems to ensure Quality Assurance on unit before installation and random sampling of units being provided to the State. BBU systems that fail will be taken off the Qualified Products List (QPL).

Department QPL testing procedures will check compliance with all the criteria of this specification including the following:

- Event logging for fault/alarm conditions
- Demonstrated use of one or more of the operating methods described in Section 3.1., “Method of Operation.”
- Testing of ability to power a 700W load for 4 hours, transfer to flash mode and power a 300W load for 2 additional hours, at an ambient temperature of +25°C.
- Testing of all components in environmental chamber (temperature ranges from -30°C to +74°C) following NEMA TS2 2003 standards, Section 2.

3.14. **Warranty, Maintenance and Support.** Provide a BBU containing a warranty that requires the manufacturer to replace failed BBUs when non-operable due to defect in material or workmanship within five years of date of purchase from manufacturer. Supply a BBU with no less than 95% of the manufacturer's warranty remaining on the date that the BBU is installed and begins operating. The replacement BBU must meet requirements of this specification. The Contractor will handle all warranty issues until the date of final acceptance.

Batteries shall be warranted for full replacement for 5 years. Batteries shall be defined as bad if they are not able to deliver 80% of battery rating.

4. MEASUREMENT

This Item will be measured by each BBU system installed.

5. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "BBU System" of the type (type of BBU cabinet) specified. This price is full compensation for furnishing, installing, and testing the completed installation, BBU system and associated equipment, mounting hardware, class B concrete pad, software, conduit, conductors; and equipment, labor, tools; and incidentals.

Special Specification 6064

Intelligent Transportation System (ITS) Pole with Cabinet

1. DESCRIPTION

Furnish, install, relocate, or remove Intelligent Transportation System (ITS) pole structures and pole mounted cabinets of the various types and sizes at locations shown on the plans, or as directed.

1.1. **ITS Equipment Application.** At a minimum, the ITS pole structure serves as the structural support for the following ITS equipment applications:

- closed circuit television (CCTV),
- fixed video,
- microwave vehicle detector (MVD) or radar vehicle sensing device (RVSD),
- bluetooth equipment,
- wireless radio equipment,
- environmental sensor station (ESS),
- solar power system, and
- pole mounted cabinets.

Ensure the equipment, design, and construction use the latest available techniques with a minimum number of different parts, subassemblies, circuits, cards, and modules to maximize standardization and commonality.

Design the equipment for ease of maintenance. All component parts must be readily accessible for inspection and maintenance. The only tools and test instruments required for maintenance by maintenance personnel must be simple hand held tools, basic meters and oscilloscopes.

2. MATERIALS

Provide materials that comply with the details shown on the plans or as directed, the requirements of this Item, and the pertinent requirements of the following Items:

- Item 416, “Drilled Shaft Foundations,”
- Item 421, “Hydraulic Cement Concrete,”
- Item 440, “Reinforcement for Concrete,”
- Item 441, “Steel Structures,”
- Item 442, “Metal for Structures,”
- Item 445, “Galvanizing,”
- Item 449, “Anchor Bolts,”
- Item 496, “Removing Structures,”
- Item 618, “Conduit,”
- Item 620, “Electrical Conductors,” and
- Item 740, “Graffiti Removal and Anti-Graffiti Coating”.

2.1. **Anchor Bolts.** Provide anchor bolts, nuts, and washers that conform with the details shown on the plans, the requirements of this Item, and in accordance with Item 449, “Anchor Bolts.”

Furnish “medium strength, mild steel” anchor bolts for anchor bolts 1 in. or less in diameter, unless otherwise shown on the plans. Furnish “alloy steel” anchor bolts for anchor bolts greater than 1 in. diameter, unless otherwise shown on the plans.

2.2. **ITS Poles.** Provide material for pole shafts that conforms to the requirements on the plans and the requirements of ASTM A1011 SS Grade 50, A572 Grade 50, A1011 HSLAS Grade 50, or A595 Grade A. Material thicknesses in excess of those stipulated under A1011 will be acceptable providing it meets all other ASTM A1011 requirements and the requirements of this specification. A595 Grade A material must have a minimum of 50 ksi yield strength adjacent to base welds after fabrication.

Fabrication plants that produce steel ITS poles must be approved in accordance with DMS-7380, “Steel Non-Bridge Member Fabrication Plant Qualification.” The Department maintains an MPL of approved ITS pole fabrication plants.

2.3. **ITS Pole Mounted Cabinet.** Provide ITS pole mounted cabinets to house ITS field equipment as shown on the plans or as directed. ITS equipment applications inside the cabinet may include, but is not limited to:

- CCTV field equipment,
- fixed video,
- radar vehicle sensing device (RVSD),
- dynamic message sign (DMS) or lane control signal (LCS) controller,
- bluetooth equipment,
- highway advisory radio (HAR),
- media conversion equipment,
- hardened ethernet switch,
- wireless radio equipment,
- environmental sensor station (ESS),
- roadway weather information system (RWIS), and
- solar power system.

Provide the cabinet with fully wired back panels, with all the necessary terminal boards, wiring, harnesses, connectors and attachment hardware for each cabinet location. Place all terminals and panel facilities on the lower portion of the cabinet walls below all shelves.

Typically, an ITS pole mounted cabinet may contain, but is not limited to, the following:

- 19-in. EIA rack,
- adjustable shelves,
- fan and thermostat,
- cabinet light,
- back panel,
- surge protection,
- terminal strips,
- interconnect harnesses with connectors,
- “Door Open” connection to back panel,
- ITS equipment hardware (as listed in Article 2.3), and
- all necessary installation and mounting hardware.

Ensure all cabinets are identical in size, shape and quality for each type as provisioned on the plans or as directed. Equip and configure the cabinet set-up as defined in this Specification and as detailed in the ITS pole with cabinet standards.

Submit details of the cabinet design and equipment layout for each cabinet to the Engineer for review and approval before fabrication.

2.4. **Electrical Requirements.**

2.4.1. **Primary Input Power Interruption.** Use material that meets all the requirements in Section 2.1.4., "Power Interruption" of the National Electrical Manufacturers Association (NEMA) Standard TS2 for traffic control system, or most current version.

2.4.2. **Power Service Transients**. Use material that meets all the requirements in Section 2.1.6., "Transients" of the NEMA Standard TS2 for traffic control system, or most current version.

2.4.3. **Power Service Protection.** Ensure that equipment contains readily accessible, manually resettable or replaceable circuit protection devices (such as circuit breakers or fuses) for equipment and power source protection. Provide circuit breakers or fuses sized such that no wire, component, connector, PC board or assembly is subjected to sustained current in excess of their respective design limits upon failure of any single circuit element or wiring.

2.4.4. **Power Distribution Panel.** Provide cabinets with a 120 VAC +/- 5 VAC power distribution panel. Provide the following components on the panel:

2.4.4.1. **Duplex Receptacles**. Provide two 120 VAC NEMA Type 5-15R duplex receptacles, or as shown on the plans, protected by a circuit breaker. Permanently label duplex receptacles "For Internal ITS Equipment Only." Install duplex receptacles in an isolated location and provide a clear 1/8 in. thick removable cover made from transparent thermoplastic material to cover the duplex receptacles. Ensure this cover is installed as not to interfere with the functional operation within the cabinet and allows enough space to plug in AC adapters and any necessary equipment. Submit alternative cover material for approval as part of the documentation submittal requirement.

2.4.4.2. **Ground Fault Circuit Interrupter (GFCI) Duplex Receptacles**. Provide at least one 120 VAC NEMA Type 5-15R GFCI duplex receptacle, or as shown on the plans, protected by a circuit breaker. This GFCI duplex receptacle is intended for maintenance personnel and is not to be used to serve equipment inside the cabinet. Permanently label GFCI duplex receptacles "For Personnel Use." Install GFCI duplex receptacles in a readily accessible location.

Provide a 120 VAC, rack mountable outlet strip with 6 NEMA Type 5-15R receptacles with surge suppression. Plug outlet strip into GFCI duplex receptacle and label for personnel use.

Circuit Breakers. Determine the ampere rating, quantity, and configuration for main, accessory, spare, and equipment circuit breakers to support ITS equipment loads as shown on the plans. Provide Underwriters Laboratories (UL) 489 listed circuit breakers capable of operating in accordance with Section 2, "Environmental Standards and Test Procedures" of NEMA TS2-2003, or most current version. Provide circuit breakers with an interrupt capacity of 5,000 A. and insulation resistance of 100 megohms at 500 VDC. Provide minimum ampere rating for the following circuit types:

2.4.4.2.1. **Main Breaker**. Size the main circuit breaker such that the load of all branch circuits is less than the main circuit breaker ampere rating in accordance with the most current version of the National Electrical Code (NEC).

2.4.4.2.2. **Accessory Breaker**. Minimum 15 A. Size accessory circuit breaker to protect lighting, door switches, fans, and GFCI duplex receptacle in accordance with the most current version of the NEC.

2.4.4.2.3. **Equipment Breakers**. Minimum 15 A. Size equipment circuit breaker to protect ITS equipment and duplex receptacles in accordance with the most current version of the NEC.

2.4.4.2.4. **Spare Equipment Breaker**. Minimum 20 A. Provide one spare equipment breaker for future use.

Furnish breakers, which are in addition to any auxiliary fuses, with the electronic equipment to protect component parts. Provide 3-terminal lightning arrestor to protect the load side of all circuit breakers. Connect

the arrestor into the circuit with size 8 AWG or larger stranded copper conductors. Connect arrestor to the line filter as recommended by the manufacturer.

2.4.4.3. **Power Line Surge Protection.** Provide and install power line surge protection devices that meet the requirements of Article 2.6.

2.4.4.4. **Power Cable Input Junction Terminals.** Provide power distribution blocks suitable for use as a power feed and junction points for 2 and 3 wire circuits. Accommodate up to No. 4 AWG conductors on the line side of each circuit. Provide appropriate sized lugs at the junction terminals for conductors larger than a No. 4 AWG when shown on the plans.

Electrically isolate the AC neutral and equipment ground wiring from the line wiring by an insulation resistance of at least 10 megohms when measured at the AC neutral. Color code the AC neutral and equipment grounding wiring white and green respectively in accordance with the most current version of the NEC.

Utilize the back panel to distribute and properly interconnect all cabinet wiring related to the specific complement of equipment called out on the plans. Each item of equipment including any furnished by the Department must have the cable harness properly terminated at terminal boards on the back panel. Ensure all functions available at the equipment connector are carried in the connector cable harness to the terminal blocks from the power distribution panel mounted on the left side panel of the cabinet.

2.4.5. **Alternative Power Option.** When shown on the plans, accommodate renewable electrical power source for the design load specified in accordance with “ITS Solar Power System” Specification. Renewable electrical power source may, or may not, be integrated with public utility electrical services, as shown on the plans or as directed. Accommodate solar system components including batteries and solar charge controller when shown on the plans.

2.4.6. **Wiring.** Ensure all cabinet wiring identified by the use of insulated pre-printed sleeving slipped over the wire before attachment of the lug or making the connection. Supply enough text on wire markers in plain words or abbreviations with sufficient level of detail so that a translating sheet will not be required to identify the type and size of wire.

Cut all wires to the proper length before assembly. Ensure no wires are doubled back to take up slack. Ensure harnesses to connectors are covered with braided cable sleeves. Secure cables with nylon cable clamps.

Provide service loops to facilitate removal and replacement of assemblies, panels and modules. Use insulated parts and wire rated for at least 600 V. Color-code harnesses and wiring.

Route and bundle all wiring containing line voltage AC separately and shield from all low voltage, i.e., control circuits. Cover all conductors and live terminals or parts, which could be hazardous to maintenance personnel, with suitable insulating material.

Provide AC internal cabinet wiring identified in accordance with the most current version of the NEC. Provide white insulated conductors for AC neutral. Provide green insulated conductors for equipment ground. Provide any color different from the foregoing on other conductors in accordance with the most current version of the NEC. For equipment that requires grounding, provide grounding conductors and do not use conduit for grounding. Provide No. 22 AWG or larger stranded conductors for internal cabinet wiring. Provide conductors that are UL-listed THHN in accordance with the most current version of the NEC. Ensure the insulation has at least a thickness of 10 mm. Ensure all wiring containing line voltage is at least size No. 14 AWG. No strands of any conductor may be trimmed to “fit” the wiring into the breaker or terminal block.

2.4.7. **Terminal Strips.** Provide terminal strips located on the back panel that are accessible to the extent that it is not necessary to remove the electronic equipment from the cabinet to make an inspection or connection.

Ensure terminal blocks are 2 position, multiple pole barrier type.

Provide shorting bars in each of the positions provided along with an integral marking strip.

Arrange terminal blocks such that they will not upset the entrance, training and connection of incoming field conductors.

Identify all terminals with legends permanently affixed and attached to the terminal blocks.

Ensure not more than 3 conductors are brought to any 1 terminal screw.

Ensure no electrically energized components or connectors extend beyond the protection afforded by the barriers.

Locate all terminal blocks below the shelves.

Ensure terminals used for field connections are secure conductors by means of a No. 10-32 nickel or cadmium plated brass binder head screw.

Ensure terminals used for interwiring connections, but not for field connections, are secure conductors by means of a No. 5-32 nickel plated brass binder head screw.

Terminate all connections to and from the electronic equipment to an interwiring type block. These blocks will act as intermediate connection points for all electronic equipment input and output.

Provide termination panels that are used to distribute and properly interconnect all cabinet wiring related to the specific complement of equipment as shown on the plans. Provide properly terminated cable harnesses for each item including any furnished by the Department. Provide all functions available at the equipment terminals that are carried in the connector cable harness.

2.4.8. **Cabinet Internal Grounding.** The cabinet internal ground consists of at least 1 ground bus-bar permanently affixed to the cabinet and connected to the grounding electrode.

Use bare stranded No. 4 AWG copper wire between bus-bars and between the bus-bar and grounding electrode when providing multiple bus-bars.

Ensure each copper ground bus-bar has a minimum of 12 connection points, each capable of securing bare conductor ranging in size from No 4 AWG to No 14 AWG.

Return AC neutral and equipment ground wiring to these bus-bars.

2.4.9. **Door Switch.** Provide door switch meeting the following requirements:

- momentary, pin-type door switch,
- installed in the cabinet or on the door, and
- connected to a terminal so that the equipment installed in the cabinet can confirm input is connected to logic ground when the cabinet door is open.

Provide 2 momentary, pin type door switches for each door provided with the cabinet. Wire 1 switch to turn on the cabinet lights when the door is open and off when the door is closed. Wire the other in parallel to a terminal block to detect a cabinet intrusion condition.

2.5. **Mechanical Requirements.**

2.5.1. **Size and Construction.** Provide ITS pole mounted cabinets meeting the configuration types detailed in the Statewide ITS pole with cabinet standards.

Table 1
Minimum Cabinet Internal Dimensions

	Depth (in.)	Width (in.)	Height (in.)
Type 1	12[1]	24	24
Type 2	18	24	36
Type 3	20	24	41

1. Minimum dimension for cabinet provided without EIA 19 in. rack assembly. Provide 18 in. minimum depth when providing EIA 19 in. rack assembly.

Determine the suitability of the listed cabinet configuration types for the equipment at each field location identified on the plans or as desired.

2.5.2. **Ventilation.** Provide the cabinet with vent openings to allow cooling of electronic components.

Locate louvered air intake vent openings on the lower portion of the cabinet doors and covered fully on the inside with a commercially available disposable 3 layer graded pleated type filter of minimum size 6 in. (high) x 12 in. (wide) for Type 1 cabinet and 12 in. (high) x 16 in. (wide) for Type 2 and 3 cabinets. Size the louvered intake area and filter to allow maximum filtered air flow and cooling, securely mounted so that any air entering the cabinet must pass through the filter. Ensure the cabinet opening for intake of air is large enough to accommodate filter size. Screen the exhaust to prevent entry of insects. Provide the screen openings no larger than 0.0125-sq. in.

Provide a, minimum of 2, thermostatically controlled fans that are adjustable with an adjustment range of 70 to 110°F. Provide a press-to-test switch to test the operation of the fan. Provide a fan with a capacity of at least 110 cfm each.

There is no opening on the roof of the cabinet.

2.5.3. **Lighting.** Provide minimum 15 W fluorescent fixtures above each door inside the cabinet, each with clear shatter proof lens. NEMA TS2 rated light-emitting diode (LED) fixtures are acceptable instead of fluorescent light fixtures. Determine the appropriate number of fixtures to achieve at least 1000 lumens to illuminate the equipment. Position the fixtures to provide illumination to the face of the equipment in the cabinet and not into a technician's eyes.

2.5.4. **Exterior Finish.** Provide cabinets with a smooth aluminum finish and the exterior in its unpainted natural color.

When shown on the plans or as directed, provide cabinets with an anti-graffiti coating in accordance with Item 740 "Graffiti Removal and Anti-Graffiti Coating."

2.5.5. **Serial Number.** Provide the cabinets with a serial number unique to the manufacturer, preceded by an assigned 2 letter manufacturer's code. Provide at least a 0.2 in. letter height. Stamp the entire identification code and number on a metal plate which is riveted to the cabinet, stamp directly on the cabinet wall, or engrave on a metalized mylar plate that is epoxied on the upper right hand cabinet side wall.

2.5.6. **Modular Design.** Provide cabinets that have a modular design and allows ITS equipment to be installed in a variety of mounting configurations as detailed on the plans or as directed.

Provide Type 1 and Type 2 cabinets with 2 unistrut or DIN rail channels on each side wall of the cabinet for mounting power panel and auxiliary ITS equipment. Provide a 19 in. EIA rack assembly only when noted on the plans or in the general notes.

Provide Type 3 cabinets with an EIA 19 in. rack assembly, sized appropriately based on cabinet type inside height dimension and is accessible from either door. Provide a rack with a minimum of one 1RU (RU = rack

unit) horizontal power strip. Provide 2 unistrut or DIN rail channels on each side wall of the cabinet for mounting power panel and auxiliary ITS equipment.

2.5.7. **Shelves.** Provide adjustable shelves in each cabinet as required to support the equipment as specified on the plans. Ensure shelf adjustment at 1 RU intervals in the vertical position. Provide shelves that can be mounted to an EIA 19 in. rack cage or unistrut channel as detailed in the standards.

Provide shelves that are removable and capable of supporting the electronic equipment. Provide a minimum of 2 in. between the back and front edge of the shelf to back inside wall and door of the cabinet respectively to allow room for the equipment cables and connectors.

Provide each cabinet type with at least 1 slide out drawer with telescoping drawer guides to allow full extension from the rack frame. Provide at least 1.75 in. (high) x 16 in. (wide), drawer sized appropriately for the cabinet with a hinged lid to allow access to storage space.

2.5.8. **Mounting Hardware.** Provide cabinets with the appropriate “U” channel mounting brackets, stiffening plates, anchor bolts, and any other necessary hardware to mount the cabinet on the ITS pole structure. Provide mounting brackets made of 0.250 in. thick steel.

Weld cabinet mounting plates to the pole. This may be done in the field for transport reasons. Do not band the cabinet or mounting plates to the pole. Design the cabinet for pole mounting and reinforce at the points of attachment to the pole

2.6. **Surge Protective Devices (SPD).** Provide SPDs to protect electronics from lightning, transient voltage surges, and induced current. Install SPDs on all power, data, video, and any other conductive circuit.

2.6.1. **120 V or 120/240 V SPD at Service and ITS Cabinet Power Distribution Panel.** Install an SPD at the closest termination or disconnection point where the supply circuit enters the cabinet. Locate the SPD on the load side of the cabinet power distribution panel breakers and ahead of any and all electronic devices. Keep leads as short as possible with all conductor bends formed to the maximum possible radius. Connect the SPD ground lead directly to the ground bus. Use of wire nuts is prohibited. Install in accordance with manufacturers recommendations.

Provide UL Listed Type 1 or Type 2 SPD and labeled to UL1449 Third Edition, posted at UL.com, under Certifications UL Category Code VZCA, and have a 20 kA I-nominal rating. Provide SPD rated as NEMA 4. SPD with integral EMI/RFI line filtering may be required if shown on the plans.

Do not exceed 700 V on the Voltage Protection Rating (VPR) on any mode (L-N, L-G, and N-G).

Do not exceed 150 V on the Maximum Continuous Operating Voltage (MCOV).

Equal or exceed 40 kA the SPD surge current rating per mode (L-N), (L-G), (N-G).

Equal or exceed 50 kA or the available short circuit current, whichever is higher for the SPD Short Circuit Current Rating (SCCR).

Provide SPD with directly connected Metal Oxide Varistors (MOV) exceeding 32 mm in diameter with thermal safety disconnectors. Gas tube and spark gap SPD are not be permitted. Ensure each MOV’s operational status can be monitored via visual indicator, including N-G mode.

Provide SPD with one set of Normally Open (NO), Normally Closed (NC) Form C contacts for remote monitoring.

Ensure the SPD utilized for AC power does not dissipate any energy and does not provide any series impedance during standby operation. Return the unit to its non-shunting mode after the passage of any surge and do not allow the shunting of AC power

2.6.2. **Parallel SPD for 120 V Equipment.** Install an SPD inside of the cabinet on the power distribution to the equipment. Keep leads as short as possible with all conductor bends formed to the maximum possible radius. Connect the SPD ground lead directly to the ground bus. Use of wire nuts is prohibited. Install in accordance with manufacturers recommendations.

Provide UL Listed Type 1 or Type 2 SPD labeled to UL1449 Third Edition, posted at UL.com, under Certifications UL Category Code VZCA, and have a 20 kA I-nominal rating. Provide SPD rated as NEMA 4.

Do not exceed 700 V on the Voltage Protection Rating (VPR) on any mode (L-N and N-G).

Do not exceed 150 V on the Maximum Continuous Operating Voltage (MCOV).

Equal or exceed 40 kA the SPD surge current rating per mode (L-N) and (N-G).

Equal or exceed 50 kA or the available short circuit current, whichever is higher for the SPD Short Circuit Current Rating (SCCR).

Provide SPD with directly connected Metal Oxide Varistors (MOV) exceeding 32 mm in diameter with thermal safety disconnectors. Gas tube and spark gap SPD are not be permitted. Ensure each MOV's operational status can be monitored via visual indicator, including N-G mode.

Provide SPD with one set of Normally Open (NO), Normally Closed (NC) Form C contacts for remote monitoring.

2.6.3. **Low-Voltage Power, Control, Data and Signal Systems SPD.** Install a specialized SPD on all conductive circuits including, but not limited to, data communication cables, coaxial video cables, and low-voltage power cables. Ensure that these devices comply with the functional requirements shown in Table 2 for all available modes (i.e., power L-N, N-G; data and signal center pin-to-shield, L-L, L-G, and shield-G where appropriate).

These specialized SPD must have an operating voltage matching the characteristics of the circuit. Ensure that these specialized SPD are UL 497B or UL 497C Listed, as applicable.

Provide the SPD with 3 stages of surge suppression in a Pi (π) configuration. The first stage (primary side) consists of parallel-connected Gas Discharge Tubes (GDTs). The second stage consists of a series connected resistor or inductor. The third stage (secondary side) consists of parallel-connected transorbs or silicone avalanche diodes (SADs).

Ground the SPD to the DIN rail and a wire terminal connection point. (Grounding solely through the DIN rail connection is not adequate and does not meet the performance or intent of this specification.)

Install coaxial SPDs in a manner that prevents ground loops and resulting signal deterioration. This is usually caused where the cable has different references to ground at either end and connecting SPDs at both ends that have only Pin to Shield protection completes a ground loop circuit through the Shield. SPDs having Pin to Shield protection, and separate Shield to Ground protection are acceptable to eliminate ground loops.

Table 2
SPD Minimum Requirements

Circuit Description	Maximum Continuous Operating Voltage (MCOV)	Frequency/ Bandwidth/ Data Rate	Surge Capacity	Maximum Let-Through Voltage
12 VDC	15-20 V	N/A	5 kA per mode (8x20 µs)	<150 Vpk
24 VAC	30-55 V	N/A	5kA per mode (8x20 µs)	<175 Vpk
48 VDC	60-85 V	N/A	5 kA per mode (8x20 µs)	<200 Vpk
Coaxial Composite Video	4-8 V	Up to 1.5 GHz	10 kA per mode (8x20 µs)	<100 Vpk
RS422/RS485	8-15 V	Up to 10 Mbps	10 kA per mode (8x20 µs)	<30 Vpk
T1	13-30 V	Up to 10 Mbps	10 kA per mode (8x20 µs)	<30 Vpk
Ethernet Data	7-12 V	Up to 100 Mbps	3kA per mode (10x1000 µs)	<30 Vpk

2.7. **Environmental Design Requirements.** Provide cabinets that meet the functional requirements of this Item during and after subjection to any combination of the following requirements:

- ambient temperature range of -30 to 165°F,
- temperature shock not to exceed 30°F per hour, during which the relative humidity does not exceed 95%,
- relative humidity range not to exceed 95% over the temperature range of 40 to 110°F, and
- moisture condensation on all surfaces caused by temperature changes.

2.8. **Vibration.** Material used must show no degradation of mechanical structure, soldered components, plug in components or satisfactory operation in accordance with the manufacturer's equipment specifications after being subjected to the vibration test as described in the NEMA standard TS2, Section 2.2.8, “Vibration Test”, or the latest revision.

3. FABRICATION

3.1. **Anchor Bolts.** Fabricate anchor bolts, nuts, and washers in accordance with the details shown on the plans and Item 449, ”Anchor Bolts.” Galvanize these items in accordance with Item 445, “Galvanization.”

Provide 2 circular steel templates as shown on the plans conforming to ASTM A36 for each assembly. Tack weld the lower anchorage nuts to the lower template in the shop. Perform this welding with an appropriate jig to ensure that the anchor bolt is perpendicular to the template. Shipping of the anchor bolt cage in its assembled condition is not required.

3.2. **ITS Poles.** Fabricate ITS poles in accordance with the details shown on the plans, this Item, and Item 441, "Steel Structures." Alternate designs are not acceptable unless approved by the Department.

Provide properly fitting components. Provide round, octagonal (8-sided), or dodecagonal (12-sided) pole shafts tapered to the heights shown on the plans.

Permanently mark, at a visible location when erected, ITS pole base plates with the design wind speed. Locate the handholes, as shown on the plans, opposite of the direction of traffic flow.

Permanently mark, at a visible location when erected, ITS pole base plates with the fabrication plant's insignia or trademark. Place the mark on the pole base plate adjacent to the handhole access compartment.

Provide circumferential welds only at the ends of the shaft. Provide no more than 2 longitudinal seam welds in shaft sections. Grind or smooth the exterior of longitudinal seam welds to the same appearance as other shaft surfaces. Ensure 100% penetration within 6 in. of circumferential base welds and 60% minimum penetration at other locations along the longitudinal seam welds. Use a welding technique that minimizes acid entrapment during later galvanizing. Hot-dip galvanize all fabricated parts in accordance with Item 445, "Galvanizing."

Fabricate air terminal and bracket assembly to serve as a lightning arrestor in accordance with ITS pole air terminal details and IEEE standards for lightning protection. Bond air terminal with air terminal bracket via clad weld or other approved bolted connection.

3.3. **Cabinet.** Continuously weld all exterior seams for cabinet and doors. Fill edges to a radius of 0.03125 in. minimum. Smooth exterior welds.

Welding on aluminum cabinets are done by the gas metal arc (MIG) or gas tungsten arc (TIG) process using bare aluminum welding electrodes. Ensure electrodes conform to the requirements of the American Welding Society (AWS) A5.10 for ER5356 aluminum alloy bare welding electrodes.

Procedures, welding machines and welding machine operators for welding on aluminum must be qualified and conform with the requirements of AWS B3.0, "Welding Procedures and Performance Qualification", and to the practices recommended in AWS C5.6.

Construct all cabinets of welded sheet aluminum with a thickness of at least 0.125 in. meeting NEMA 3R standards. Do not allow wood, wood fiber product, or flammable products in the cabinet. Seal cabinet structure to prevent the entry of rain, dust, and dirt.

Provide a sunshield on the exterior top of the cabinet to reflect solar rays and mitigate temperature build-up inside the cabinet. Construct sunshield out of 0.125 in. thick aluminum and provide a minimum of 1.25 in. clearance above the top of cabinet secured in four locations.

Attach aluminum lifting eyes or ears to the top of the cabinet to permit lifting the cabinet with a sling. Lifting eyes may be permanently fabricated to the cabinet frame as long as they do not interfere with the construction and operation of the sunshield. Manufacturer may provide removable lifting eyes that can be removed after installation. Seal any penetrations to the cabinet exterior or sunshield after removal of lifting eyes.

Ensure cabinets conform to the requirements of ASTM designation: B209 for 5052-H32 aluminum sheet.

3.3.1. **Door.** Provide sturdy and torsionally rigid cabinet doors that substantially cover the full area of the cabinet access opening. Attach cabinet doors by a minimum of 2 heavy duty hinges or full length hinge. Provide stainless steel hinge pins.

Fabricate the doors and hinges to withstand a 100 lb. per vertical ft. force applied to the outer edge of the door when open without permanent deformation or impairment of the door or cabinet body when the load is removed.

Fit the cabinet doors with Number 2 Corbin locks and aluminum or chrome plated handles with a minimum 3/8 in. drive pin and a 3 point latch. Design the lock and latch so that the handles cannot be released until the lock is released. Provide a locking ring for a padlock along with a padlock. Provide 2 keys for the door and 2 keys for the padlock with each cabinet. Locate the lock clear of the arc of the handle. Keys must be removable in the locked position only. Mount locks with 2 stainless steel machine screws. Provide cabinet doors with a catch mechanism to hold the door open at 2 positions: 90º and 120°.

Fabricate the door and door stop mechanism to withstand a simulated wind load of 5 lb. per sq. ft. applied to both inside and outside surfaces without failure, permanent deformation, or compromising of door position.

Provide cabinets without auxiliary police doors.

Provide a gasket to act as a permanent and weather resistant seal at the cabinet door facing. The gasket material must be of a non-absorbent material and maintain its resiliency after long term exposure to the outdoor environment.

Provide a gasket with a minimum thickness of 0.25 in. Locate the gasket in a channel provided for this purpose either on the cabinet or on the door. An "L" bracket is acceptable instead of this channel if the gasket is fitted snugly against the bracket to insure a uniformly dust and weather resistant seal around the entire door facing.

3.3.2. **Mechanical Components.** Ensure all external screws, nuts, and locking washers are stainless steel. Do not use self-tapping screws unless specifically approved by the Engineer.

Ensure all parts are made of corrosion resistant material, such as plastic, stainless steel, aluminum or brass.

Ensure all materials used in construction are resistant to fungus growth and moisture deterioration.

Separate dissimilar metals by an inert dielectric material.

4. CONSTRUCTION

4.1. **Installation.** Locate ITS poles as shown on the plans unless otherwise directed to secure a more desirable location or to avoid conflict with utilities. Stake the ITS pole locations for verification by the Engineer.

Use established industry and utility safety practices when working near underground or overhead utilities. Consult with the appropriate utility company before beginning such work.

Construct foundations for new ITS poles in accordance with Item 416, "Drilled Shaft Foundations," and the details shown on the plans." Orient anchor bolts as shown on the plans. Install conduit per Item 618, Conduit."

Identify all items of a shipment with a weatherproof tag. This tag minimally must identify manufacturer, contract number, and date and destination of shipment.

Erect poles after foundation concrete has attained its design strength as required on the plans and Item 421, "Hydraulic Cement Concrete." Coat anchor bolt threads and tighten anchor bolts in accordance with Item 449, "Anchor Bolts." Do not grout between the base plate and the foundation.

Mount the pole mounted cabinet to the backside of the ITS pole, with door either parallel or perpendicular to the roadway, away from the direction of traffic flow, as shown on the plans. Mount cabinet plumb in all directions.

For ITS pole sites located on slopes greater than 4H:1V, mount the pole mounted cabinet to the backside of the ITS pole, from the perspective parallel to the roadway with the door facing the direction of traffic flow as shown on the plans.

Install grounding conductor from cabinet and ITS pole air terminal inside a minimum 1 in. PVC conduit within the foundation. Bond grounding conductors to the primary ground rod as part of the grounding ring in accordance with the ITS grounding details.

Construct reinforced maintenance pad, when required, with Class A concrete in accordance with Item 421, “Hydraulic Cement Concrete.” Provide reinforcing steel in accordance with Item 440, “Reinforcing Steel.”

4.2. **Relocation.** Before removal of the existing pole structure or cabinet, disconnect and isolate the power cables from the electric power supply and disconnect all cables (power and communication) from the equipment and remove any ITS equipment, associated mounting brackets, pole mounted cabinet, and cabling from the pole structure. Remove existing pole structure as shown on the plans only at such time as authorized by the Engineer.

Inspect the existing pole structure, with a representative from the Department, and document any evidence of structural stress cracks or fatigue before removal. Remove and deliver to the Department, existing pole structures that fail structural inspection to an address to be supplied by the Department.

Remove the existing pole structure in a manner acceptable to the Engineer using a method that does not cause undue overstress or damage to the structure or appurtenances attached.

Use a crane of sufficient capacity to remove the pole. Disconnect and relocate the existing pole structure from and to the foundation as shown on the plans in a manner acceptable to the Engineer.

When the poles are laid down, place the poles on timber cribbing so that the poles lie reasonably straight to prevent any damage or deterioration.

Maintain safe construction and operation practices at all times. Handle the poles in such a manner during removal so as to prevent damage to the pole's exterior finish. The Contractor will be responsible for any damage to poles.

Unless otherwise shown on the plans, remove abandoned concrete foundations, including steel, to a depth of at least 2 ft. below final grade in accordance with Item 496, “Removing Structures.” Backfill the excavation with materials equal in composition and density to the surrounding area. Replace any surfacing material with similar material to an equivalent condition.

Supply all new anchor bolts required for the installation of the ITS pole structure. Match bolt dimensions and lengths previously used or as shown on the plans and as directed. Provide anchor bolts in accordance with Item 449, “Anchor Bolts.”

Move existing poles to the locations shown on the plans or as directed. Construct new foundations for relocated ITS poles in accordance with Item 416, "Drilled Shaft Foundations," and the details shown on the plans. Install conduit per Item 618, “Conduit.” Install existing poles on new foundations in accordance with Section 4.1, “Installation.” Do not grout between the base plate and foundation.

4.3. **Removal.** Use established industry and utility safety practices when removing poles and assemblies located near overhead or underground facilities. Consult with the appropriate utility company before beginning work.

Inspect the pole and cabinet, where included, with a representative from the Department, and remove any ITS equipment, associated mounting hardware, and cabling still attached to the pole or inside the cabinet before commencing work. Inspect the existing pole and cabinet in place, with a representative from the Department, and document any evidence of damage to the representative before removal.

Before removal of the existing pole structure or cabinet, disconnect and isolate the power cables from the electric power supply and disconnect all cables (power and communication) from the equipment. Remove and coil existing cabling to the nearest ITS ground box or as identified on the plans.

Carefully remove the cabinet from the pole structure. Avoid damage or injury to surrounding objects or individuals. Deliver the cabinet to an address to be supplied by the Department.

Carefully remove the pole from the foundation in accordance with Item 496, “Removing Structures.” Avoid damage or injury to surrounding objects or individuals. Separate the pole at the slip-fitted connections, if applicable. If the pole cannot be separated, transport the complete pole or partially separate the pole to make it transportable. Deliver the pole structure to an address to be supplied by the Department.

Unless otherwise shown on the plans, remove abandoned concrete foundations, including steel, to a depth of 2 ft. below final grade in accordance with Item 496, “Removing Structures.” Backfill the excavation with materials equal in composition and density to the surrounding area. Replace surfacing material with similar material to an equivalent condition.

4.4. **Testing.**

4.4.1. **Installation**. Unless otherwise shown on the plans, perform the following tests on cabinets supplied through this Item.

4.4.1.1. **Test Procedures Documentation**. Provide 5 copies of the test procedures to include tests identified in Article 4.4.2 through Article 4.4.4 inclusive and blank data forms to the Engineer for review and comment at least 45 days before testing for each test required on this project. Include the sequence of the tests in the procedures. The Engineer will comment, approve, or reject test procedures within 30 days after Contractor submittal of equipment for tests. Contractor to resubmit if necessary rejected test procedures for final approval within 10 days before testing. Review time is calendar days. Conduct all tests in accordance with the approved test procedures. The Department may witness all tests.

Record test data on the data forms and quantitative results. No bid item measurement or payment will be made until the Engineer has verified the test results meet the requirements of the specification. The data forms for all tests, except design approval tests, must be signed by an authorized representative of the Contractor.

Provide written notice to the Engineer within 48 hr. of discovery of any testing discrepancy performed in testing by the contractor. Furnish data forms containing the acceptable range of expected results and measured values.

4.4.1.2. **Design Approval Test**. Conduct a design approval test on 10% of the total number of cabinets supplied as part of the project, with at least one of each type of cabinet used on the project.

Certification from an independent testing laboratory of a successfully completed design approval test is acceptable. Ensure that the testing by this laboratory is performed in accordance with the requirements of this specification. Failure of independent tests to comply with the requirements of this specification will be grounds for rejection of any certification.

Provide a copy of the certification to the Engineer. The data forms for the design approval tests must be signed by an authorized representative (company official) of the equipment manufacturer or by an authorized representative of an independent testing facility.

Notify the Engineer 10 working days before conducting this testing. The Department may witness all the tests. Perform the following tests:

4.4.1.2.1. **Power Service Transients**. Provide equipment that meets the performance requirements, specified in this Item, when subjected to the power service transients as specified in NEMA TS2, Section 2.2.7.2, “Transient Tests (Power Service)”, or most current version.

4.4.1.2.2. **Temperature and Condensation**. Provide equipment that meets the performance requirements, specified in this Item, when subjected to the following conditions in the order specified below:

- stabilize the equipment at -30°F and test as specified in NEMA TS2, Sections 2.2.7.3, “Low-Temperature Low-Voltage Tests” and 2.2.7.4, “Low-Temperature High-Voltage Tests”, or most current version.
- Allow the equipment to warm up to room temperature in an atmosphere with relative humidity of at least 40%. Operate the equipment for 2 hr., while wet, without degradation or failure.
- Stabilize the equipment at 165°F and test as specified in NEMA TS2, Sections 2.2.7.5, “High-Temperature High Voltage Tests” and 2.2.7.6, “High-Temperature Low-Voltage Tests”, or most current version.

4.4.1.2.3. **Relative Humidity**. Provide equipment that meets the performance requirements, specified in this Item, within 30 min. of being subjected to a temperature of 165°F and a relative humidity of 18% for 48 hr.

4.4.1.2.4. **Vibration**. Provide equipment that shows no degradation of mechanical structure, soldered components, or plug-in components and will operate in accordance with the manufacturer's equipment specifications after being subjected to the vibration tests as described in NEMA TS2, Section 2.2.8, “Vibration Test”, or most current version.

4.4.1.2.5. **Power Interruption**. Provide equipment that meets the performance requirements, specified in this Item, when subjected to nominal input voltage variations as specified in NEMA TS2, Section 2.2.10, “Power Interruption Test”, or most current version.

4.4.1.3. **Stand-Alone Tests**. Conduct a Stand-Alone Test for each cabinet after installation. Exercise all stand-alone (non-network) functional operations consisting of the following, at a minimum:

- 19-inch EIA rack,
- adjustable shelves,
- locking mechanism,
- fan and thermostat,
- cabinet light,
- back panel,
- circuit breakers,
- surge protection,
- grounding system,
- terminal strips,
- interconnect harnesses with connectors,
- cabinet attachment to pole,
- weatherproofing, and
- “Door Open” connection to back panel.

Notify the Engineer 5 working days before conducting this test. The Engineer may witness all the tests.

4.4.1.4. **Consequences of Test Failure**. If a unit fails a test, submit a report describing the nature of the failure and the actions taken to remedy the situation before modification or replacement of the unit. If a unit requires modification, correct the fault and then repeat the test until successfully completed. Correct minor discrepancies within 30 days of written notice to the Engineer. If a unit requires replacement, provide a new unit and then repeat the test until successfully completed. Major discrepancies that will substantially delay receipt and acceptance of the unit will be sufficient cause for rejection of the unit.

Failure to satisfy the requirements of any test is considered a defect and the equipment is subject to rejection by the Engineer. The rejected equipment may be offered again for retest provided all noncompliance has been corrected.

If a failure pattern develops in similar units within the system, implement corrective measures, including modification or replacement of units, to all similar units within the system as directed. Perform the corrective measures within 30 calendar days without additional cost or extension of the contract period.

4.4.1.4.1. **Consequences of Design Approval Test Failure**. If the equipment fails the design approval test, correct the fault within 30 days and then repeat the design approval test until successfully completed.

4.4.1.4.2. **Consequences of Stand-Alone Test Failure**. If the equipment fails the stand-alone test, correct the fault within 30 days and then repeat the stand-alone test until successfully completed.

4.4.2. **Relocation.**

4.4.2.1. **Pre-Test**. Conduct performance testing before removal of ITS pole mounted cabinet. Test the following components or equipment, at a minimum, and document functional operations in the presence of representatives of the Contractor and the Department.

- locking mechanism,
- fan and thermostat,
- cabinet light,
- back panel,
- circuit breakers,
- surge protection system,
- grounding system, and
- “Door Open” connection to back panel.

Ensure that both representatives sign the test report indicating that the equipment has passed or failed each function. Once removed, the equipment becomes the responsibility of the Contractor until accepted by the State. Compare test data before removal and test data after installation.

4.4.2.2. **Post Test**. Testing of the ITS pole mounted cabinet is for the purpose of relieving the Contractor of maintenance of the system. The Contractor will be relieved of the responsibility for maintenance of the system in accordance with Item 7, “Legal Relations and Responsibilities”, after a successful test period. The Contractor will not be required to pay for electrical energy consumed by the system.

After all existing ITS equipment has been installed, perform the same functional operation test described under Article 4.4.2.1. Furnish test data forms containing the sequence of tests including all of the data taken and quantitative results for all tests. Submit the test data forms to the Engineer at least 30 days before the day the tests are to begin. Obtain Engineer’s approval of test procedures before submission of equipment for tests. Send at least 1 copy of the data forms to the Engineer.

The performance test results after relocation must be equal to or better than the test results before removal. Repair or replace those components within the system which failed after relocation but which passed before removal.

The Department will conduct approved ITS equipment system tests on the field equipment hardware with the central equipment. The tests will, as a minimum, exercise all remote control functions and display the return status codes from the controller.

If any unit fails to pass a test, prepare a report and deliver it to the Engineer. Describe in the report the nature of the failure and the corrective action needed. If the failure is the result of improper installation or damage during reinstallation, reinstall or replace the unit and repeat the test until the unit passes successfully, at no additional cost to the Department or extension of the contract period.

4.5. **Documentation.** Submit documentation for this Item consisting of the following:

4.5.1. **ITS Pole.** Shop drawings should clearly detail the following for the ITS poles submitted for the project:

- physical pole drawings,
- anchor bolts,
- material list,
- lightning suppression,
- weatherheads,
- cabinet Mounting attachments (when cabinet required), and
- grounding system.

4.5.2. **Pole Mounted Cabinet.** Shop drawings should clearly detail the following for ITS pole mounted cabinets when required as shown on the plans:

- dimensions,
- shelves,
- door,
- gasket,
- door look,
- materials list,
- exterior finish,
- ventilation,
- terminal strips,
- harnesses,
- filter,
- power distribution panel,
- surge suppression,
- back panel,
- outlets,
- circuit breakers,
- power cable terminals,
- wiring diagrams,
- cabinet grounding,
- environmental parameters, and
- connectors.

Submit shop drawings, signed, sealed, and dated by a registered professional Engineer in Texas showing the fabrication and erection details for each ITS pole including the ITS cabinet and mounting details in accordance with Item 5, “Control of the Work”.

Provide at least 2 complete sets of operation and maintenance manuals in hard copy format in addition to a CD/DVD or removable flash drive that include the following:

- complete and accurate schematic diagrams,
- complete installation procedures,
- complete performance specifications (functional, electrical, mechanical and environmental) on the unit,
- complete parts list including names of vendors for parts not identified by universal part number such as JEDEC, RETMA, or EIA,
- pictorial of component layout on circuit board,
- complete maintenance and trouble-shooting procedures,
- complete stage-by-stage explanation of circuit theory and operation,
- recovery procedures for malfunction, and
- instructions for gathering maintenance assistance from manufacturer.

Identify material which is copyrighted or proprietary in nature as part of the documentation submittal. The Department will take proper provisions to secure such material and not distribute without written approval.

Provide Department with certification documentation verifying conformance with environmental and testing requirements contained in the special specification. Certifications may be provided by the manufacturer or through independent labs.

4.6. **Warranty.** The start date of the manufacturer’s standard warranty will begin when the stand-alone test plan has been approved. Any equipment with less than 95% of its warranty remaining at the beginning of the stand-alone test will not be accepted by the Department. Guarantee that equipment furnished and installed

for this project performs according to the manufacturer's published specifications. Warrant the equipment against defects or failure in design, materials, and workmanship for a minimum of 5 years or in accordance with the manufacturer's standard warranty if warranty period is greater. Assign, to the Department, all manufacturer's normal warranties or guarantees on all electronic, electrical, and mechanical equipment, materials, technical data, and products furnished for and installed on the project. Repair or replace, at the manufacturer's option, defective equipment during the warranty period at no cost to the Department.

Repair or replace equipment at the Contractor's expense before beginning testing in the event of a malfunction or failure. Furnish replacement parts for all equipment within 30 days of notification of failure by the Department.

5. MEASUREMENT

This Item will be measured as each unit furnished, installed, relocated, or removed as shown on the plans, excluding new foundations and conduit.

6. PAYMENT

6.1. **Furnish and Install.** The work performed and materials furnished in accordance with this Item and measured as provided for under "Measurement" will be paid for at the unit price bid for "ITS Pole" of the type and height specified, including COSS/OSB extension, and "ITS Pole Mount Cabinet" of the type and configuration specified. This price is full compensation for furnishing, fabricating, and erecting ITS pole structures as shown on the plans; for furnishing, fabricating, and installing ITS pole mounted cabinets as shown on the plans; for furnishing and placing anchor bolts, nuts, washers, and templates; conducting cabinet testing; and equipment, materials, labor, tools, and incidentals necessary to provide an ITS pole structure or pole mounted cabinet complete in place and ready for the attachment of ITS equipment.

New drill shaft foundations will be paid for under Item 416, "Drilled Shaft Foundations." New conduit will be paid for under Item 618, "Conduit."

6.2. **Install Only.** The work performed and materials furnished in accordance with this Item and measured as provided for under "Measurement" will be paid for at the unit price bid for "ITS Pole (Install Only)" of the type and height specified, including COSS/OSB extension, and "ITS Pole Mount Cabinet (Install Only)" of the type and configuration specified. This price is full compensation for erecting ITS pole structures and installing ITS pole mounted cabinets furnished by the Department as shown on the plans; for installing and placing anchor bolts, nuts, washers, and templates; conducting cabinet testing; and equipment, materials, labor, tools, and incidentals necessary to provide an ITS pole structure or pole mounted cabinet, complete in place, and ready for the attachment of ITS equipment.

New drill shaft foundations will be paid for under Item 416, "Drilled Shaft Foundations." New conduit will be paid for under Item 618, "Conduit."

6.3. **Relocate.** The work performed and materials furnished in accordance with this Item and measured as provided for under "Measurement" will be paid for at the unit price bid for "ITS Pole (Relocate)" of the type and height specified, including COSS/OSB extension, and "ITS Pole Mount Cabinet (Relocate)" of the type and configuration specified. This price is full compensation for removing existing ITS pole structures or pole mounted cabinets as shown on the plans; removing existing foundations; backfilling and surface placement; hauling and erecting ITS pole structures; hauling and installing ITS pole mounted cabinets; furnishing and placing anchor bolts, nuts, washers, and templates; conducting cabinet testing; and equipment, materials, labor, tools, and incidentals necessary to relocate existing ITS pole structures or pole mounted cabinets, complete in place, and ready for the attachment of ITS equipment.

New drill shaft foundations will be paid for under Item 416, "Drilled Shaft Foundations." New conduit will be paid for under Item 618, "Conduit."

6.4. **Remove.** The work performed and materials furnished in accordance with this Item and measured as provided for under “Measurement” will be paid for at the unit price bid for “ITS Pole (Remove)” of the type and height specified, including COSS/OSB extension, and “ITS Pole Mount Cabinet (Remove)” of the type and configuration specified. This price is full compensation for removing existing ITS pole structures and pole mounted cabinets as shown on the plans; removing existing foundations; backfilling and surface placement; loading and hauling; and equipment; materials, labor, tools, and incidentals necessary to complete the removal of existing ITS pole structures and pole mounted cabinets.

Special Specification 6185

Truck Mounted Attenuator (TMA) and Trailer Attenuator (TA)

1. DESCRIPTION

Furnish, operate, maintain and remove upon completion of work, Truck Mounted Attenuator (TMA) or Trailer Attenuator (TA).

2. MATERIALS

Furnish, operate and maintain new or used TMAs or TAs. Assure used attenuators are in good working condition and are approved for use. A list of approved TMA/TA units can be found in the Department's Compliant Work Zone Traffic Control Devices List. The host vehicle for the TMA and TA must weigh a minimum of 19,000 lbs. Host vehicles may be ballasted to achieve the required weight. Any weight added to the host vehicle must be properly attached or contained within it so that it does not present a hazard and that proper energy dissipation occurs if the attenuator is impacted from behind by a large truck. The weight of a TA will not be considered in the weight of the host vehicle but the weight of a TMA may be included in the weight of the host vehicle. Upon request, provide either a manufacturer's curb weight or a certified scales weight ticket to the Engineer.

3. CONSTRUCTION

Place or relocate TMA/TAs as shown on the plans or as directed. The plans will show the number of TMA/TAs needed, for how many days or hours, and for which construction phases.

Maintain the TMA/TAs in good working condition. Replace damaged TMA/TAs as soon as possible.

4. MEASUREMENT

4.1. **Truck Mounted Attenuator/Trailer Attenuator (Stationary).** This Item will be measured by the each or by the day. TMA/TAs must be set up in a work area and operational before a calendar day can be considered measurable. When measurement by the day is specified, a day will be measured for each TMA/TA set up and operational on the worksite.

4.2. **Truck Mounted Attenuator/Trailer Attenuator (Mobile Operation).** This Item will be measured by the hour. The time begins once the TMA/TA is ready for operation at the predetermined site and stops when notified by the Engineer. A minimum of 4 hr. will be paid each day for each operating TMA/TA used in a mobile operation.

5. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Truck Mounted Attenuators/Trailer Attenuators (Stationary)," or "Truck Mounted Attenuators/Trailer Attenuators (Mobile Operation)." This price is full compensation for furnishing TMA/TA: set up; relocating; removing; operating; fuel; and equipment, materials, tools, labor, and incidentals.

Special Specification 6186

Intelligent Transportation System (ITS) Ground Box

1. DESCRIPTION

Construct, furnish, install or remove Intelligent Transportation System (ITS) ground boxes for fiber optic communication infrastructure complete with lids.

2. MATERIALS

Provide new materials that comply with the details shown on the plans, the requirements of this Item, and the requirements of the following items:

- Item 420, "Concrete Substructures,"
- Item 421, "Hydraulic Cement Concrete,"
- Item 432, "Riprap,"
- Item 440, "Reinforcement for Concrete,"
- Item 471, "Frames, Grates, Rings, and Covers,"
- Item 618, "Conduit", and
- Item 620, "Electrical Conductors."

Provide new ITS ground boxes constructed of precast concrete or polymer concrete in accordance with the National Electrical Code (NEC) and National Electrical Manufacturers Association (NEMA) standards, most current version. Faulty fabrication or poor workmanship in materials, equipment, or installation will be justification for rejection. Provide manufacturer's warranties or guarantees when offered as a customary trade practice.

2.1. **Precast Concrete.** Provide precast concrete ground boxes and aprons that comply with the details shown on the plans, the requirements of this Item, and in accordance with the following:

- construct ground boxes with Class A concrete in accordance with Item 421, "Hydraulic Cement Concrete," unless otherwise directed,
- provide American Society for Testing and Materials (ASTM) A 615 Grade 60 reinforcement steel in accordance with Item 440, "Reinforcing Steel," and
- provide steel for the frames and covers in accordance with Item 471, "Frames, Grates, Rings, and Covers," unless otherwise approved by the Engineer.

2.1.1. **Loading Requirements.** Designed to withstand American Association of State Highway and Transportation Officials (AASHTO) H-20 loading. Manufacturer must furnish certification of conformance with H-20 loading.

2.2. **Polymer Concrete.** Manufacture ground box and ground box cover from polymer concrete reinforced with 2 continuous layers of fiberglass fabric. Provide fabricated precast polymer concrete ground boxes and aprons that comply with the details shown on the plans, the requirements of this Item, and in accordance with American Standards Institute (ANSI)/Society of Cable Telecommunications Engineers (SCTE) - ANSI/SCTE 77, most current version.

- **Polymer Concrete.** Construct polymer concrete from catalyzed polyester resin, sand, and aggregate. Polymer concrete containing chopped fiberglass or fiberglass-reinforced plastic is prohibited. Ensure a minimum compressive strength of 11,000 psi.

- **Fiberglass Fabric.** The base glass on the fiberglass fabric must be alumina-limeborosilicate type "E" glass. The reinforcing fabric must line the entire inner and outer surfaces. Obtain approval for the fabric prior to production.

2.2.1. **Loading Requirements.** All polymer concrete boxes and covers must meet all test provisions of the ANSI/SCTE 77 Tier 22 requirements. All polymer concrete boxes and covers will be UL Listed or manufacture must provide a certification from an NRTL or factory-testing documentation witnessed and certified by professional engineer licensed in Texas.

Ensure ground box withstands 800 lb. per sq. ft. of force applied over the entire sidewall with less than 1/4 in. deflection per foot length of box. Ensure ground box and ground box cover withstand a test load of 33,750 lb. over a 10 in. x 20 in. area centered on the cover with less than 1/2 in. deflection at the design load of 22,500 lb.

3. EQUIPMENT

3.1. **Size.** Provide ITS ground boxes meeting the configuration types detailed in Table 1.

Table 1
Ground Box Inside Dimensions

Type	Width (Inches)	Length (Inches)	Depth (Inches)
Type 1 (Precast)	24	36	36, 48, or 60
Type 2 (Precast)	36	60	36, 48, or 60
Type 1 (Polymer)	24	36	24, 36, or 48
Type 2 (Polymer)	36	60	24, 36, or 48

3.2. **Shape.** Provide ITS ground boxes rectangular in shape.

3.3. **Aprons.** Provide concrete aprons for ground boxes installed in native ground as shown on the plans. Aprons will be omitted when the ground boxes are located in riprap, sidewalk, or landscape pavers.

3.4. **Bolts.** Provide stainless steel penta bolts or special keyed bolts, as required by Department, with associated hardware as shown on plans. Provide self-draining bolt holes. Washers must be provided with all bolts.

3.5. **Accessories.** Include all necessary provisions for knockouts, cable racking, adapters and terminators for proper conduit and cable installation.

3.5.1. **Knockouts.** Provide knockouts at the factory to accommodate the appropriate number and size of conduits entering the ground box as shown in the plans. Within the factory, score or provide indention on each outside wall identifying additional conduit entry points for future expansion that does not impact the rebar structure. Place a bell fitting on the end of each conduit to ensure a flush fit inside the ground box. Place concrete grout in the knockout (inside and out), around the conduit and bell fitting to ensure a neat and watertight fit. Ensure that the grout does not enter the inside of the conduit.

3.5.2. **Cable Racking.** Provide steel (ASTM A-153), non-metallic glass reinforced nylon, or equivalent cable rack assemblies with the dimensions shown on the plans.

3.5.3. **Terminators.** Terminators must be appropriately sized for the conduits indicated on plans and must be an airtight and watertight connection.

Terminators for the PVC conduits should be placed symmetrically about the centerline of the box at the depth shown on plans.

Terminators that do not have conduits attached must be capped and sealed as shown on the plans.

Install the quantity, size, and location of terminators as shown on plans.

3.6. **Cover Requirements.**

3.6.1. **Type of Cover.** Provide the following types of covers based on the type of ground box:

- Precast concrete ground box: Provide a 1-piece or 2-piece galvanized steel or cast iron cover depending on the ground box type. Provide a torsion assisted cover for Type 2 ground box with lids that can open freely a minimum 90º each and lock in place with locking latches or a pin-lock inserted in the hinge. Covers must be grounded in accordance with the requirements of the most current version of the NEC. Provide the cover with drop handles.
- Polymer concrete ground box: Provide a 1-piece or 2-piece cover depending on the ground box type, bolted to the ground box. Cover must have a minimum of 2 lifting eyes.

3.7. **Label.** Permanently mark all ground boxes and covers with the manufacturer's name or logo and model number. Legibly imprint each cover with a permanently marked logo in letters at least 1 in. high as follows: "DANGER—HIGH VOLTAGE TRAFFIC MANAGEMENT", unless otherwise directed. Glue in logos are prohibited.

3.8. **Security.** Equip all ground box covers with a stainless steel penta head or keyed bolting system that will securely hold the cover in place. Provide an appropriate means to secure or lock the cover in place as required by the plans.

3.9. **Skid Resistance.** All ground box covers must be skid resistant and should have a minimum coefficient of friction of 0.50 on the top surface of the cover. Provide certification minimum coefficient of friction value is met as part of material documentation.

3.10. **Strength Requirements.** The following ground box strengths are required based on the following 2 applications.

3.10.1. **Deliberate Roadway Traffic.** Precast concrete ground boxes with steel covers must be used in locations that may experience deliberate, continuous vehicular traffic, such as near the shoulder or an auxiliary lane, or immediately adjacent to the unprotected edge of pavement. Do not place ground boxes in the paved travel lanes or shoulder of highways, frontage roads, streets, bridges, or driveways.

Ground boxes and covers located in these areas must be rated for heavy-duty traffic loading and meet an AASHTO H-20 design loading.

Precast concrete ground boxes and covers located in non-deliberate heavy vehicular traffic must still meet AASHTO H-20 design loading.

3.10.2. **Non-Deliberate Heavy Vehicular Traffic.** Polymer concrete ground boxes and covers may be used in off roadway applications subject to occasional non-deliberate heavy vehicular traffic, such as driveways, along sidewalks, parking lots and behind non-mountable curb. Polymer ground boxes and covers located in these areas must meet ANSI/SCTE Tier 22 loading requirements.

4. CONSTRUCTION

Perform work in accordance with the details shown on the plans and the requirements of this Item.

Use established industry and utility safety practices when installing or removing ground boxes located near underground utilities. Consult with the appropriate utility company before beginning work.

4.1. **Installation.** Install ground boxes as shown on the plans. Maintain spacing as shown on the plans.

Ground box locations may be revised to fit existing field conditions or to better facilitate the installation of the conduit system with approval by the Engineer.

Field-locate ground boxes to avoid steep slopes and low-lying locations with poor drainage.

Construct ground box cover to fit properly on ground box.

When installing ground boxes in surfaced areas, make the tops of the ground boxes flush with the finished surface.

4.1.1. **Gravel at Base of Ground Box.** Install all ground boxes on a bed of crushed rock at the base of the excavation as shown on the plans. Place 12 in. of washed, crushed stone (1.5 in. nominal) which extends 6 in. in all directions from the perimeter of the box. Lightly tamp the gravel immediately prior to the placement of the ground box to reduce settlement. Crushed gravel will not be paid directly, but be considered subsidiary to this Item.

4.1.2. **Cable Racking Installation.** Provide and locate cable rack assemblies designed to support up to 25 ft. of slack for each fiber optic cable inside each Type 1 ground box, 100 ft. of slack for each fiber optic cable inside each Type 2 ground box, slack associated with other communication cabling, and any splice enclosure as shown on the plans or as directed. Cable racks may be installed at the factory or in the field. Place the racks in a manner so as not to impede access in and out of the ground box.

Ground metallic cable rack assemblies to grounding system inside ground box in accordance with the most current version of the NEC.

Use fasteners with an ultimate pull out strength of at least 2500 lb. and ultimate shear strength of at least 3000 lb. When securing cable racks to side walls of ground box in the field, seal all penetrations to the side wall to prevent moisture and contaminant penetration. Sufficient cable supports must be provided for the particular of conductors or cables coiled or passing through the ground as shown on the plans or directed by the Engineer.

4.1.3. **Buried Installation.** When shown in the plans or identified in the General Notes, bury ground boxes for security measures. When burying ground boxes, provide polymer concrete ground boxes meeting ANSI/SCTE Tier 22 loading requirements.

Provide 12 in. cover between ground surface and top of ground box lid. Prior to backfilling, provide a 30 lb. felt paper over the entire ground box extending a minimum of 2 in. from either side to prevent backfill materials from entering ground box.

4.2. **Excavation and Backfill.** Ensure excavation and backfill for ground boxes meets the requirements as set forth by Item 400, “Excavation and Backfill for Structures.” For buried ground boxes, compact backfill material in order to prevent depressions in ground surface from occurring over the ground box.

4.3. **Testing.** Ground box and cover must be tested by a laboratory independent of the manufacturer to meet loading requirements. Certificate of such tests must be submitted to the Engineer for approval.

4.4. **Documentation Requirements.** Submit documentation for this Item consisting of the following for Engineer approval prior to installation:

- record Global Positioning System (GPS) coordinates using NAD83 datum for all ground boxes prior to backfill. Identify location to obtain coordinates on drawing detail,
- shop drawings,

- concrete mix design,
- material specifications for ground box, lid, cable racks, bolts, and skid resistance for cover
- testing certification for loading requirements,
- hot, cold, and wet weather plan, and
- backfill material composition.

Shop drawings should clearly detail the following for ground boxes, at a minimum:

- dimensions
- knockouts
- cable racks
- terminators
- adapters
- bolts
- cover
- load rating
- cover lock

4.5. **Removal.** Remove existing ground boxes and concrete aprons to at least 6 in. below the conduit level. Uncover conduit to a sufficient distance so that 90º bends can be removed and conduit reconnected. Clean the conduit in accordance with Item 618, "Conduit." Replace conduit within 5 ft. of the ground box. Remove old conductors and install new conductors as shown on the plans. Backfill area with material equal in composition and density to the surrounding area. Replace surfacing material with similar material to an equivalent condition.

5. MEASUREMENT

This Item will be measured by each ground box installed or removed.

6. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "ITS Ground Box (Precast Concrete)" of the various types and sizes specified" or "ITS Ground Box (Polymer Concrete)" of the various types and sizes specified and for "Remove ITS Ground Box".

6.1. **Furnish and Install.** This price is full compensation for excavating and backfilling; constructing, furnishing and installing the ITS ground boxes and concrete aprons when required; and all labor, tools, equipment, materials, transportation, accessories, documentation, testing and incidentals.

Conduit will be paid for under Item 618, "Conduit" and Special Specification 6016, "ITS Multi-Duct Conduit."

Electrical conductors will be paid for under Item 620, "Electrical Conductors."

6.2. **Remove.** This price is full compensation for removing and disassembling ground boxes and concrete aprons; excavation, backfilling, and surface placement; removing old conductors; disposal of unsalvageable materials; and materials, equipment, labor, tools, and incidentals. Cleaning of conduit is subsidiary to this Item. Conduit replaced within 5 ft. of the ground box will be subsidiary to this Item.

Special Specification 6277

Install Large Ground Mounted and Overhead Signs Furnished by the State

1. DESCRIPTION

Collect, transport and install sign panels for overhead and large ground mounted structures furnished by the Department. Sign supports are provided for under other items.

2. MATERIALS

Install sign panel materials supplied by the department as shown on the plans or as directed. When required, provide new materials that comply with the details shown on the plans, the requirements of this Item, and the pertinent requirements of the following:

- Item 636, "Aluminum Signs"
- Item 647, "Large Roadside Sign Supports and Assemblies"
- Item 650, "Overhead Sign Supports

3. CONSTRUCTION

Remove existing signs on sign supports as shown on the plans or as directed. Remove and store existing signs as necessary. Collect, transport and install new signs furnished by the Department. Prevent damage to sign components. Damage to the new sign face that is visible when viewed at a distance of 50 ft. or more, night or day, will be unacceptable. Replace unacceptable signs and components. Reuse existing attachment hardware as directed. Furnish additional sign attachment hardware when required or as directed. Adjust existing sign supports as shown on the plans or as directed.

Handle and store removed signs to prevent damage to sign corners, edges, and faces. Store signs off the ground and in a vertical position. Return removed sign components for recycling to the Department at the district grounds. Accept ownership of unsalvageable or excess materials and dispose of in accordance with federal, state, and local regulations.

After installation, wash signs with a biodegradable cleaning solution acceptable to the manufacturers of the sheeting, colored transparent film, and screen ink to remove grease, oil, dirt, smears, streaks, finger marks, and other foreign material.

4. MEASUREMENT

This Item will be measured by square foot of new sign panel installed.

5. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Install State Supplied Sign Panels." This price is full compensation for replacing large ground mounted and overhead sign panels on existing sign supports; installing large ground mounted signs at new locations; furnishing and installing new mounting hardware; cleaning sign panels; storing of components to be reused or salvaged; disposal of unsalvageable material; and equipment, labor, tools, and incidentals. The adjustment of existing sign supports is subsidiary to this bid item.

Special Specification 6304

Intelligent Transportation System (ITS) Radar Vehicle Sensing Device

1. DESCRIPTION

Furnish, install, relocate, or remove Intelligent Transportation System (ITS) radar vehicle sensing device (RVSD) system at locations shown on the plans, or as directed.

2. MATERIALS

2.1. General. Except as allowed for relocation of RVSD equipment, ensure all equipment and component parts are new and in an operable condition at time of delivery and installation. Ensure all RVSD within the project are from the same manufacturer. RVSD are further classified by the type of functions they can perform. The primary classifications are RVSD (Data Collection Only) and RVSD (Data Collection and Wrong-way alarm).

Provide RVSD field equipment that is compatible with existing infrastructure and software located in the Department's Traffic Management Centers (TMCs) across the state or as directed.

RVSD system equipment must include the following:

- Radar vehicle sensing devices
- Mounting assembly and hardware
- All cabling and connector assemblies
- Associated devices required to integrate into communication system

RVSD must be a roadside sensor, or group of sensors, that accurately provides volume, speed, occupancy, and classification data for the roadway segment where they are installed.

Ensure sensor is designed and constructed with subassemblies, circuits, cards, and modules to maximize standardization and commonality. Ensure all external parts and surfaces are designed to protect against corrosion, fungus and moisture deterioration.

Design the equipment for ease of maintenance. Provide component parts that are readily accessible for inspection and maintenance. Provide test points for checking essential voltages and waveforms.

RVSD must self-recover from power failure once power is restored.

Sensor must be provided with a mounting bracket designed to mount directly to a pole, mast-arm, or other structure. Ensure bracket is designed such that the sensor can be tilted both vertically and horizontally for alignment and then locked into place after proper alignment is achieved. All hardware must be designed to support the load of the RVSD sensor and mounting bracket.

2.2. Configuration. Each RVSD system consists of roadside sensors as shown on the plans. Ensure the RVSD system detects a minimum of eight lanes. Ensure lane width, medians, and geometry are configurable. Traffic barriers must not interfere with detection.

Ensure RVSD does not require tuning or recalibration to maintain performance once initial calibration and configuration is complete. RVSD must not require cleaning or adjustment to maintain performance.

Ensure RVSD can detect vehicles within a range of 10 to 200 feet from the sensor and can simultaneously detect vehicles in all lanes within the detection range of the radar.

2.3. Automatic Detection. Once installed and aligned, ensure the sensor automatically detects vehicle volume, speed, and occupancy. Ensure only minor operator input is required for setup, such as verification of lane configuration and distance from sensor. Ensure the sensor tunes out stationary objects to omit false readings.

2.4. Data Collection. The RVSD must automatically calibrate vehicle speed, detection level, and sensitivity. Ensure RVSD provides accurate, real-time volume, average speed, and occupancy for each lane detected.

RVSD must provide user configurable settings for collection and polling intervals. Interval configurations must include options ranging from twenty seconds to 15 minutes or more.

RVSD must be able to correctly categorize detected vehicles into a minimum of three user definable length-based classification bins.

Ensure RVSD sensor performance is not affected by environmental conditions such as shadows, glare, wind, rain, heat, or snow. Ensure speed detection is accurate without requiring vehicle length for calculations.

Ensure RVSD system includes remote connection capabilities allowing an operator to update configuration and firmware as well as download interval data. In the event of communication loss, ensure RVSD stores and transfers data upon communication restoration and subsequent request for data.

Ensure RVSD sensor provides non-volatile memory for configuration settings and for local storage. The sensor must store a minimum of 3 hours of data for all data collected over eight travel lanes at twenty-second intervals. Ensure local storage data is overwritten in a first-in first-out manner.

Ensure RVSD supports the Department's Transportation Sensor System Protocol Document (TSS-Protocol) as detailed in the *TSS Tools* link on the Department's website (http://www.txdot.gov/business/resources/engineering-software.html).

2.5. Accuracy. Ensure RVSD accuracy meets or exceeds the following requirements during nominal conditions:

- Sensor volume data accuracy is within 5 percent of actual per direction of travel.
- Sensor average speed data is accurate within 5 mph per direction of travel.
- Individual lane speed accuracy is within 10 mph of actual.
- Individual vehicle speed accuracy is within 5 mph for 90% of measurements.
- Vehicle classification data is accurate for 90% of detected vehicles.

2.6. Functional Requirements for RVSD with Wrong-way Alarms. RVSD with wrong-way alarms must be capable of detecting and reporting direction of travel for each vehicle detected as well as include all features and functions required for Data Collection RVSD.

The RVSD sensor must automatically determine if a vehicle is traveling in the opposite direction for which the lane is configured.

Ensure the RVSD can detect real-time vehicle direction of travel.

2.7. Cabling. Supply the RVSD with all cabling of the appropriate length for each installation site.

2.8. Communication. RVSD must be remote accessible and provide communication options including RS-232, RS-485 and TCP/IP.

RVSD communication through RS-232 or RS-485 must include an internal RS-232, RS-485 communication port. Each serial communication port must support the following baud rates: 9600, 19200, 38400, 57600 and

115200. Additionally, the RS-232 port must be full-duplex and must support true Request to Send / Clear to Send (RTS/CTS) hardware handshaking for interfacing to various communication devices.

RVSD system must produce interval data packets containing all available criteria as detailed in TSS-Protocol.

2.9. Software. Ensure the RVSD manufacturer includes all software required to configure and monitor operation of RVSD field equipment locally and remotely. RVSD software must be a stable production release.

Software must allow the user to configure, operate, exercise, diagnose, and read current status of all RVSD features and functions using a laptop computer.

RVSD system computer software must be able to communicate with RVSD field devices using TCP/IP and serial connections, including cellular modem connections. The software must provide for local and remote configuration and monitoring, including a graphical user interface (GUI) that displays all configured lanes and provides visual representation of all detected vehicles.

System software must provide the user complete control over the configuration and setup process for RVSD devices and allow the user to load new firmware into non-volatile memory of RVSD field devices locally and over any supported communication channel including TCP/IP networks.

Software must include the ability to save a local copy of RVSD field device configurations, and load saved configurations to RVSD field devices.

Ensure the software allows the operator to change the baud rate via a drop-down list, add response delays for the communication ports to allow for communication stabilization, switch between data pushing and data polling, and change the RVSD's settings for Flow Control between none and RTS/CTS. Ensure the software automatically selects the correct baud rate and serial communication port from up to 15 serial communication ports.

The software must include the ability to retrieve and store data collected by RVSD field devices.

Ensure all licenses required for operation and use of software are included at no additional cost.

Software updates must be provided at no additional cost during the warranty period.

2.10. Mechanical. Ensure that all parts are fabricated from corrosion resistant materials, such as plastic, stainless steel, aluminum, or brass.

Ensure that all screws, nuts, and locking washers are stainless steel. Do not use self-tapping screws.

Ensure equipment is clearly and permanently marked with manufacturer name or trademark and part number as well as date of manufacture or serial number.

Ensure RVSD system is modular in design for ease of field replacement and maintenance. Ensure cable connector design prohibits improper connections. Cable connector pins are plated to improve conductivity and resist corrosion. RVSD sensor dimensions must not exceed 14 in. by 11 in. by 7 in.

Ensure the RVSD housing is a weather resistant, ultraviolet (UV) resistant material. RVSD sensor must meet NEMA 250 4X requirements. Ensure all gasket and sealant materials are UV resistant and intended to be used in outdoor environment with exposure to the sun.

All printed circuit boards (PCB) must have conformal coating.

2.11. Electrical. Ensure the RVSD system operates on nominal 120 V_{AC}. Provide a transformer with any system device that requires a nominal operating voltage other than 120 V_{AC}. Ensure RVSD sensor operates between

12 V_{DC} and 28 V_{DC} utilizing ten watts or less. Ensure equipment is designed to protect personnel from exposure to high voltage during installation, operation, and maintenance.

2.12. Environmental. All RVSD system components must operate properly during and after being subjected to the environmental testing procedures described in NEMA TS2, Section 2. RVSD sensor must be able to withstand the maximum wind load defined in the Department's basic wind velocity zone map standard without any damage or loosening from structure.

2.13. Connectors and Harnesses. External connections exposed to the outdoor environment must be made with weatherproof connectors. Connectors must be keyed to ensure correct alignment and mating.

Ensure all conductors are properly color coded and identified. Ensure that every conductive contact surface or pin is gold-plated or made of a noncorrosive, nonrusting, conductive metal.

Ensure power and data cable connectors exposed to the elements are IP 67 compliant. Ensure all conductors that interface with the connector are encased in one jacket.

RS-485 and RS-232 communication cables must:

- be shielded, twisted pair cable with a drain wire,
- have a nominal capacitance conductor to conductor @ 1Khz ≥ 26pF/ ft.,
- have nominal conductor DC resistance @ 68°F ≤ 15 ohms/1000 ft.,
- be one continuous run with no splices, and
- be terminated only on the two farthest ends of the cable.

2.14. Documentation. Provide hardcopy operation and maintenance manuals, along with a copy of all product documentation on electronic media. Include the following documentation for all system devices and software:

- operator manuals,
- installation manuals with installation procedures,
- maintenance and troubleshooting procedures, and
- manufacturer's specifications (functional, electrical, mechanical, and environmental).

Provide certification from an independent laboratory demonstrating compliance with NEMA TS2 environmental requirements for temperature, humidity, transients, vibration, and shock.

RVSD system must transmit in the 10.50 – 10.55 GHz or 24.00 – 24.25 GHz frequency band and meets the power transmission and frequency requirements of CFR 47. Ensure FCC certification is displayed on each device according to FCC rules. Provide third party test results for CFR 47, Part 15 (Section 15.245 or 15.249).

The RVSD enclosure must conform to criteria set forth in the NEMA 250 Standard for Type 4X enclosures. Provide third party enclosure test results demonstrating the sensor enclosure meets Type 4X criteria.

Ensure the RVSD system manufacturer has a quality assurance program for manufacturing RVSD as described in this specification. Manufacturer of the RVSD must be ISO 9001 certified, or provide a copy of the company quality manual for review.

The RVSD must pass testing to ensure functionality and reliability prior to delivery. These include functional tests for internal subassemblies, a 24 hr. minimum unit level burn-in test, and a unit functionality test. Test results and supporting documentation, including serial number tested, must be submitted for each RVSD. If requested, manufacturing data per serial number must be provided for each RVSD.

2.15. Warranty. Warrant the equipment against defects or failure in design, materials, and workmanship for a minimum of 5 yr. or in accordance with the manufacturer's standard warranty if that warranty period is greater. The start date of the manufacturer's standard warranty will begin after the equipment has successfully passed all tests contained in the final acceptance test plan. Any equipment with less than 90%

of its warranty remaining after the final acceptance test is completed will not be accepted by the Department. Guarantee that equipment furnished and installed for this project performs according to the manufacturer's published specifications. Assign, to the Department, all manufacturer's normal warranties or guarantees on all electronic, electrical, and mechanical equipment, materials, technical data, and products furnished for and installed on the project.

Malfunctioning equipment must be repaired or replaced at the Contractor's expense prior to completion of the final acceptance test plan. Furnish replacement parts for all equipment within 10 days of notification of failure by the Department.

During the warranty period, technical support must be available via telephone within 4 hr. of the time a call is made by a user, and this support must be available from factory certified personnel.

2.16. Training. Conduct a training class for a minimum of 8 hr., unless otherwise directed, for up to 10 representatives designated by the Department on installation, configuration, operation, testing, maintenance, troubleshooting, and repair. Submit a training session agenda, a complete set of training material, the names and qualifications of proposed instructors, and proposed training location for approval at least 30 days before the training. Conduct training within the local area unless otherwise directed. Provide 1 copy of course material for each attendee. Ensure that training includes:

- "Hands-on" operation of system software and equipment;
- explanation of all system commands, their function and usage; and
- system "troubleshooting," operation, and maintenance.

3. CONSTRUCTION

3.1. System Installation. Install RVSD system devices according to the manufacturer's recommendations to achieve the specified accuracy and reliability. Completion of the work must present a neat, workmanlike, and finished appearance.

If the RVSD is to be mounted near large planar surfaces (sound barrier, building, parked vehicles, etc.), verify the final placement meets manufacturer recommendations for installation and clearance.

Ensure installation and configuration of software on Department computers is included with the RVSD system.

3.2. Mechanical Components. Ensure that all fasteners, including bolts, nuts, and washers with a diameter less than 5/8 in. are Type 316 or 304 stainless steel and meet the requirements of ASTM F593 and ASTM F594 for corrosion resistance. Ensure that all bolts and nuts 5/8 in. and over in diameter are galvanized and meet the requirements of ASTM A307. Separate dissimilar metals with an inert dielectric material.

3.3. Wiring. All wiring and electrical work supplying the equipment must meet the requirements of the most current version of the National Electrical Code (NEC). Supply and install all wiring necessary to interconnect RVSD sensors to the field cabinet and incidentals necessary to complete the work. If additional cables are required, the Contractor must furnish and install them at no additional cost to the Department. Provide conductors at least the minimum size indicated on the plans and insulated for 600 V.

Cables must be cut to proper length prior to assembly. Provide cable slack for ease of removal and replacement. All cable slack must be neatly laced with lacing or straps in the bottom of the cabinet. Ensure cables are secured with clamps and include service loops.

3.4. Electrical Service. The Contractor is responsible for checking the local electrical service to determine if a modification is needed for the equipment.

3.5. Grounding. Ensure all RVSD system devices, cabinets, and supports are grounded in accordance with the NEC and manufacturer recommendations.

3.6. Relocation of RVSD Field Equipment. Perform the relocation in strict conformance with the requirements herein and as shown on the plans. Completion of the work must present a neat, workmanlike, and finished appearance. Maintain safe construction practices during relocation.

Inspect the existing RVSD field equipment with a representative from the Department and document any evidence of damage prior to removal. Conduct testing in accordance with 4.9. Remove and deliver equipment that fails inspection to the Department.

Prior to removal of existing RVSD field equipment, disconnect and isolate the power cables from the electric power supply and disconnect all communication cabling from the equipment located inside the cabinet. Coil and store power and communication cabling inside the cabinet until such time that it can be relocated. Remove existing RVSD field equipment as shown on the plans only at such time as authorized by the Engineer.

Use care to prevent damage to any support structures. Any equipment or structure damaged or lost must be replaced by the Contractor (with items approved by the Engineer) at no cost to the Department.

Make all arrangements for connection to power and communications including any permits required for the work to be done under the Contract. Provide wire for the power connection at least the minimum size indicated on the plans and insulated for 600 V.

3.7. Removal of RVSD Field Equipment. Perform the removal in strict conformance with the requirements herein and as shown on the plans. Completion of the work must present a neat, workmanlike, and finished appearance. Maintain safe construction practices during removal.

Inspect the existing RVSD field equipment with a representative from the Department and document any evidence of damage prior to removal. Conduct testing in accordance with 4.9.

Disconnect and isolate any existing electrical power supply prior to removal of existing field equipment.

Use care to prevent damage to any support structures. Any equipment or structure damaged or lost must be replaced by the Contractor (with items approved by the Engineer) at no cost to the Department.

All materials not designated for reuse or retention by the Department will become the property of the Contractor and be removed from the project site at the Contractor's expense. Deliver items to be retained by the Department to a location shown on the plans or general notes. The Contractor is fully responsible for any removed equipment until released by the Engineer.

3.8. Contractor Experience Requirements. Contractor or designated subcontractor must meet the following experience requirements:

3.8.1. Minimum Experience. Three years of continuous existence offering services in the installation of RVSD systems. Experience must include freeway and arterial management, forward fire and side fire applications, single zone and dual beam detection, and equipment setup, testing, and troubleshooting.

3.8.2. Completed Projects. Three completed projects where personnel installed, tested and integrated RVSD field equipment. The completed installations must have been in continuous satisfactory operation for a minimum of 1 yr.

3.8.3. Equipment Experience. One project (may be 1 of the 3 projects in the preceding paragraph) in which the personnel worked in cooperation with technical representatives of the equipment supplier to perform installation, integration, or acceptance testing of the work. The Contractor will not be required to furnish equipment on this project from the same supplier who was referenced in the qualification documentation.

Submit the names, addresses and telephone numbers of the references that can be contacted to verify the experience requirements given above.

4. TESTING

Ensure that the following tests are performed on equipment and systems unless otherwise shown on the plans. The Department may witness all the tests.

4.1. Test Procedures Documentation. Provide an electronic copy of the test procedures and blank data forms 60 days prior to testing for each test required on this project. Include the sequence of the tests in the procedures. The Engineer will approve test procedures prior to submission of equipment for tests. Conduct all tests in accordance with the approved test procedures.

Record test data on the data forms, as well as quantitative results. Ensure the data forms are signed by an authorized representative (company official) of the equipment manufacturer.

4.2. Design Approval Test. Ensure that the RVSD has successfully completed a Design Approval Test that confirms compliance with the environmental requirements of this specification.

Provide a certification and test report from an independent testing laboratory as evidence of a successfully completed Design Approval Test. Ensure that the testing by this laboratory is performed in accordance with the requirements of this specification.

4.3. Demonstration Test. Conduct a Demonstration Test on applicable equipment at an approved Contractor facility. Notify the Engineer 10 working days before conducting this testing. Perform the following tests:

4.3.1. Examination of Product. Examine each unit carefully to verify that the materials, design, construction, markings and workmanship comply with the requirements of this specification.

4.3.2. Continuity Tests. Check the wiring to determine conformance with the requirements of this specification.

4.3.3. Operational Test. Operate each unit for at least 15 min. to permit equipment temperature stabilization and observation of a sufficient number of performance characteristics to ensure compliance with this specification.

4.4. Stand-Alone Test. Conduct a Stand-Alone Test for each unit after installation. The test must exercise all stand-alone (non-network) functional operations. Notify the Engineer 5 working days before conducting this test.

4.4.1. Performance Test. Ensure the RVSD meets functional performance requirements of Section 2.5 by using the following test methods:

Verify volume and classification accuracy by performing a manual count on each lane of detection. Volume and classification data reported by the sensor must meet the volume and classification data accuracy requirements in Section 2.5 when compared with data collected manually.

Verify speed accuracy by comparing sensor speed data to speeds data collected with a laser speed gun, radar speed gun, or by video speed trap using frame rate as a time reference. Vehicle speeds must be collected and averaged over a minimum of 10 vehicles. Speed data must meet the speed data accuracy requirements in Section 2.5 when compared to average speeds collected using laser, radar, or video.

Verify wrong-way detection accuracy by reversing the configured direction of travel for at least one travel lane. Verify vehicles detected in a reversed lane are classified as wrong-way vehicles and properly counted. Volume reported for vehicles classified as wrong-way must meet the volume data accuracy requirement in Section 2.5.

4.5. System Integration Test. Conduct a System Integration Test on the complete functional system. Demonstrate all control and monitor functions for each system component for 72 hr. Supply 2 copies of the System Operations manual before the System Integration Test. Notify the Engineer 10 working days before conducting this testing.

4.6. Consequences of Test Failure. If a unit fails a test, submit a report describing the nature of the failure and the actions taken to remedy the situation prior to modification or replacement of the unit. If a unit requires modification, correct the fault and then repeat the test until successfully completed. Correct minor discrepancies within 30 days of written notice to the Engineer. If a unit requires replacement, provide a new unit and then repeat the test until successfully completed. Major discrepancies that will substantially delay receipt and acceptance of the unit will be sufficient cause for rejection of the unit.

If a failure pattern develops in similar units within the system, implement corrective measures, including modification or replacement of units, to all similar units within the system as directed. Perform the corrective measures without additional cost or extension of the Contract period.

4.7. Final Acceptance Test. Conduct a Final Acceptance Test on the complete functional system. Demonstrate all control, monitoring, and communication requirements and operate the system for 90 days. The Engineer will furnish a Letter of Approval stating the first day of the Final Acceptance Test. The completion of the Final Acceptance Test occurs when system downtime due to mechanical, electrical, or other malfunctions to equipment furnished or installed does not exceed 72 hr. and any individual points of failure identified during the test period have operated free of defects.

4.8. Consequences of Final Acceptance Test Failure. If a defect within the system is detected during the Final Acceptance Test, document and correct the source of failure. Once corrective measures are taken, monitor the point of failure until a consecutive 30 day period free of defects is achieved.

If after completion of the initial test period, the system downtime exceeds 72 hr. or individual points of failure have not operated for 30 consecutive days free of defects, extend the test period by an amount of time equal to the greater of the downtime in excess of 72 hr. or the number of days required to complete the performance requirement of the individual point of failure.

4.9. Relocation and Removal

4.9.1. Pre-Test. Tests may include, but are not limited to, physical inspection of the unit and cable assemblies. Include the sequence of the tests in the procedures along with acceptance thresholds. Contractor to resubmit, if necessary, rejected test procedures for final approval within 10 days. Review time is calendar days. Conduct all tests in accordance with the approved test procedures.

Conduct basic functionality testing prior to removal of RVSD field equipment. Test all functional operations of the equipment in the presence of representatives of the Contractor and the Department. Ensure that both representatives sign the test report indicating that the equipment has passed or failed each function. Once removed, the equipment becomes the responsibility of the Contractor until accepted by the Department. Compare test data prior to removal and after installation. The performance test results after relocation must be equal to or better than the test results prior to removal. Repair or replace those components within the system that failed after relocation but passed prior to removal.

4.9.2. Post-Test. Testing of the RVSD field equipment is to relieve the Contractor of system maintenance. The Contractor will be relieved of the responsibility for system maintenance in accordance with Item 7, “Legal Relations and Responsibilities” after a successful test period. The Contractor will not be required to pay for electrical energy consumed by the system.

After all existing RVSD field equipment has been installed, conduct approved continuity, stand alone, and performance tests. Furnish test data forms containing the sequence of tests including all the data taken as well as quantitative results for all tests. Submit the test data forms to the Engineer at least 30 days prior to the day the tests are to begin. Obtain Engineer’s approval of test procedures prior to submission of equipment for tests. Send at least 1 copy of the data forms to the Engineer.

Conduct an approved stand-alone test of the equipment installation at the field sites. At a minimum, exercise all stand-alone (non-network) functional operations of the field equipment installed per the plans as directed by the Engineer. Complete the approved data forms with test results and turn over to the Engineer for review and either acceptance or rejection of equipment. Give at least 30 working days notice prior to all tests to permit the Engineer or his representative to observe each test.

The Department will conduct approved RVSD field equipment system tests on the field equipment with the central equipment. The tests will, as a minimum, exercise remote control functions and confirm communication with field equipment.

If any unit fails to pass a test, prepare and deliver a report to the Engineer. Describe the nature of the failure and the corrective action needed. If the failure is the result of improper installation or damage during reinstallation, reinstall or replace the unit and repeat the test until the unit passes successfully, at no additional cost to the Department or extension of the Contract period.

5. MEASUREMENT

RVSD for data collection only will be measured by each unit furnished and installed, installed, relocated or removed. RVSD for data collection and wrong-way alarm will be measured by each system furnished and installed, installed, relocated or removed.

6. PAYMENT

6.1. Furnish and Install. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit bid price for "ITS RVSD (Data Collection Only) System" and "ITS RVSD (Data Collection and Wrong-way alarm) System." This price is full compensation for furnishing, installing, configuring, integrating, and testing the completed installation including RVSD equipment, voltage converters or injectors, cables, connectors, associated equipment, and mounting hardware; and for all labor, tools, equipment, any required equipment modifications for electrical service, documentation, testing, training, software, warranty and incidentals necessary to complete the work.

6.2. Install Only. The work performed and materials furnished in accordance with this Item will be paid for at the unit bid price for "ITS RVSD (Data Collection Only) (Install Only)" and "ITS RVSD (Data Collection and Wrong-way alarm) (Install Only)." This price is full compensation for installing, configuring, integrating, and testing the completed installation including RVSD equipment, voltage converters or injectors, cables, connectors, associated equipment, and mounting hardware; and for all labor, tools, equipment, any required equipment modifications for electrical service, documentation, testing, training, software, and incidentals necessary to complete the work.

6.3. Relocate. The work performed and materials furnished in accordance with this Item will be paid for at the unit bid price for "ITS RVSD (Data Collection Only) (Relocate)" and "ITS RVSD (Data Collection and Wrong-way alarm) (Relocate)." This price is full compensation for relocating and making fully operational existing RVSD field equipment; furnishing and installing additional cables or connectors; for testing, delivery and storage of components designated for salvage or reuse; and all testing, training, software, equipment, any required equipment modifications for electrical service, labor, materials, tools, and incidentals necessary to complete the work.

6.4. Remove. The work performed and materials furnished in accordance with this Item will be paid for at the unit bid price for "ITS RVSD (Data Collection Only) (Remove)" and "ITS RVSD (Data Collection and Wrong-way alarm) (Remove)." This price is full compensation for removing existing RVSD equipment; removal of cables and connectors; for testing, delivery and storage of components designated for salvage; and all testing, training, software, equipment, labor, materials, tools, and incidentals necessary to complete the work.

Special Specification 6405
Ground Boxes

1. DESCRIPTION

- Installation. Construct, furnish, and install ground boxes complete with lids.

2. MATERIALS

Provide new materials that comply with the details shown on the plans, the requirements of this Item, and the pertinent requirements of the following items:

- Item 420, “Concrete Substructures,”
- Item 421, “Hydraulic Cement Concrete,”
- Item 432, “Riprap,”
- Item 440, “Reinforcement for Concrete,”
- Item 618, “Conduit,” and
- Item 620, “Electrical Conductors.”

Provide fabricated precast polymer concrete ground boxes in accordance with DMS-11070, “Ground Boxes.”

Provide other precast polymer concrete ground boxes that comply with DMS-11070 except the dimensions and other details shown on the plans.

3. CONSTRUCTION

Perform work in accordance with the details shown on the plans and the requirements of this Item.

Use established industry and utility safety practices when installing or removing ground boxes located near underground utilities. Consult with the appropriate utility company before beginning work.

3.1. Installation. Fabricate and install ground boxes in accordance with the details, dimensions, and requirements shown on the plans. Install ground box to approved line and grade.

Construct concrete aprons as shown on the plans and in accordance with Item 432, “Riprap,” and Item 440, “Reinforcement for Concrete.”

4. MEASUREMENT

This Item will be measured by each ground box installed complete in place or each ground box removed.

5. PAYMENT

The work performed and materials furnished, in accordance with this Item and measured as provided under “Measurement,” will be paid for at the unit price bid for “Ground Box” of the types and sizes specified and for “Remove Ground Box.”

5.1. Installation. This price is full compensation for excavating and backfilling; constructing, furnishing, and installing ground boxes and concrete aprons; and material, equipment, labor, tools, and incidentals. All wiring connections required inside the ground box will be considered subsidiary to this bid item. Conduit will be paid for under Item 618, “Conduit.” Electrical conductors will be paid for under Item 620, “Electrical Conductors.”

Special Specification 6406
Lighting Protection System

1. DESCRIPTION

This Special Specification governs the design and installation of Lightning Protection System (LPS) for Electronic Toll Collection (ETC) sites.

2. MATERIALS

Furnish new material in accordance with the details shown on the plans, the requirements of this Item, and the pertinent requirements of the following Items, references and standards, except for measurement and payment:

- Item 416, "Drilled Shaft Foundations,"
- Item 618, "Conduit,"
- Item 620, "Electrical Conductors,"
- Item 624, "Ground Boxes,"
- Item 628, "Electrical Services,"
- Item 650, "Overhead Sign Supports," and
- TXDOT Traffic Engineering Standard Sheets – (ED) Electrical Details.

2.1. Standards. LPS components must comply with the requirements of the following standards unless otherwise specified on the plans or approved.

- National Fire Protections Association (NFPA) 70, National Electrical Code (NEC): Latest edition at the time of construction.
- NFPA 780 Standard for Installation of Lightning Protections Systems: Latest edition at the time of construction.
- Underwriters Laboratory Standard UL 96.

2.2. Products. Air terminals will be solid aluminum, copper-clad steel, or as shown on the plans.

Ground Rods, Ground Loop Conductors, and Concrete-Encased Electrodes must comply with the plans, specifications, and applicable portions of the standards listed in this specification. Plan requirements should govern over standards. The Engineer may approve alternate equivalent materials when proposed by the contractor.

Copper-Aluminum connections should be made with UL listed connectors intended for the purpose.

Exothermic welded connections, when shown on the plans, should be made in accordance with manufacturer's instructions. Bolted connections embedded in concrete should be UL listed for the purpose.

3. CONSTRUCTION

Install LPS components and systems according to the plans, specifications, and the standards listed in this specification.

3.1. Conduit. Install conduits of the type and size shown on the plans. Conduits should be embedded in concrete columns when shown on the plans.

3.2. Air Terminals. Install LPS air terminals at locations shown on the plans. Steel trusses and columns with thickness greater than 3/16 in. need not be equipped with air terminals unless shown on the plans.

3.3. Conductors. Install LPS cross-run and down conductors of the type and size required. Install conductors with direct paths from air terminals to ground connections. Avoid sharp bends and narrow loops. Conductor location, mounting, or attachment, type and size as required by the plans or as approved.

- Install ground rings, ground rods, test wells, and other components as shown on the plans. Path or route modifications may be made to accommodate field conditions. Bond rebar to down conductor or ground ring at top and bottom of all columns and at top of all drill shafts a minimum of two places on opposite sides of the column or shaft.
- Bond trusses that are mounted on concrete columns to down conductors in two places. Trusses mounted to metal columns or sign bridge legs need not be bonded unless shown on the plans. Bond steel columns or sign bridge legs to the ground rings.
- Bond all metal parts, such as hand rails and guard rails, within 6 ft. of ground ring to the ground ring whether or not the connection is shown on the plans. All bonding should be done with lugs, clamps, exothermic welds, or other UL listed hardware.

3.4. Bonding. Ensure that LPS is bonded to the equipment grounding conductor provided with the wiring from the electrical service. This connection should be made by bonding the LPS to the grounding bus in the Toll Equipment Cabinet (TEC.)

3.5. Ground Test Well. Install LPS ground test well of the type and size shown on the plans.

3.6. Quality Control. Quality Control requirements:

- LPS Installer Qualifications: Engage experienced installer who is NRTL listed or who is certified by LPI as Master Installer and Designer.
- LPS Listing and Labeling: As defined in NFPA 780, Article 2-2, “Definitions.” All components will be labeled and listed as required by NFPA 780.
- LPS Quality Control Field Inspections: Provide reports indicating compliance with plans and specification requirements.
- LPS UL Inspection: Apply for inspection by UL, as required, to obtain UL Master Label for system.
- LPS UL Master Label: Provide UL Master Label.
- LPS: Provide as-built drawings of Lightning Protection System.

4. MEASURMENT

This Item will be measured by each Lightning Protection System complete in all respects including furnishing, installation, testing, and affixing a UL Master Label.

5. PAYMENT

The work performed and materials furnished, in accordance with this Item and measured as provided under “Measurement,” will be paid for at the unit price bid for “Lightning Protection System” of the type and size specified and the installation method specified as applicable. This price is full compensation for furnishing and installing the Lightning Protection System, including but not limited to, strike termination devices, conductors, ground electrode system, bonding to metal objects, all connections, conduit, hanging, strapping, drilling, tunneling, excavating, and furnishing and placing backfill; replacing pavement structure, sod, riprap, curbs, or other surface, marking location of conduit (when required), furnishing and installing fittings, junction boxes, and expansion joints; and equipment, labor, tools, and incidentals. Unless otherwise shown on the plans, conduit embedded in or on walls, columns or foundations for encasing LPS conductors will be paid for under item 618, “Conduit.”

Special Specification 6407
Full Color LED Variable Message Sign System

1. DESCRIPTION

Furnish and install full color matrix Light Emitting Diode (LED) Variable Message Signs (VMS) with nominal 18 in. tall characters. With each color VMS, furnish and install equipment cabinet with VMS controller at the base of the sign's support structure. Provide manufacturer approved end user training.

In the case of conflicts between standards and specifications, the latest State of Texas and Department standards and specifications will govern.

2. MATERIALS

2.1. **General Requirements.** All materials furnished, assembled, fabricated, or installed under this Item must be new, corrosion resistant, and in strict accordance with this item and the pertinent requirements of the following:

- NEMA TS 4, latest edition,
- TxDOT Special Specification "Intelligent Transportation System (ITS) Ground Mounted Cabinet,"
- TxDOT Special Specification, "Installation of Dynamic Message Sign System," for installation,
- TxDOT Special Specification "Testing, Training, Documentation, Final Acceptance, and Warranty," and
- vendor must be ISO 9001 registered.

Furnish at least 4 licensed copies of vendor software on Department laptops for each VMS, ensuring at least one CD, DVD, or electronic copy is delivered, should the licensed copy need to be reinstalled. Any auxiliary software needed for execution or diagnostics will be supplied by the vendor.

Ensure that all materials and construction methods, necessary to complete the installation, conform to the requirements of the Item, the plans, and the pertinent requirements of the following items.

- Item 432, "Riprap"
- Item 441, "Steel Structures"
- Item 445, "Galvanizing"
- Item 449, "Anchor Bolts"
- Item 618, "Conduit"
- Item 620, "Electrical Conductors"
- Item 656, "Foundations for Traffic Control Devices"

Ensure that the sign displays symbols, graphics, and character fonts approved for VMS use by the TMUTCD and its accompanying reference documents.

Furnish the following equipment at each VMS field site shown on the plans.

- Full Color LED VMS, capable of rear mounting onto sign supports specified on TxDOT Standard Details MDM, OSB, COSS, and DMS latest versions.
- Sign Controller with software, NTCIP compliant.
- VMS mounting brackets and hardware.
- Electrical power connectors at VMS and controller, as specified by the VMS manufacturer.
- Telecommunications cabling and connectors between VMS and controller as specified by the VMS manufacturer when required.

- Power and communication cabling and connectors from controller to VMS must follow NEMA TS4, Section 4, "Controller to Sign Interface."
- Communications as shown on the plans.
- VMS cabinet (ground mount) and electronics.
- Documentation.
- All incidentals required for installing a VMS sign.

2.2. **Dynamic Message Sign.** Ensure that the full color matrix LED VMS meets the following requirements:

- The color LED VMS should enable the display of text consisting of a string of alphanumeric and other characters.
- Each character must be formed by a matrix of luminous pixels.
- All display elements and modules should be solid state.
- No mechanical or electromechanical elements or shutters should be used.
- The configuration details of signs described by this specification can be seen in Table 1 below.

Table 1

Sign Type	Front Access
Matrix Type	Full
LED - Type	AlInGaP Red LEDs InGaN Blue LEDs InGaN Green LEDs
LED Color – Wavelength	Red – 618-630 nm Blue – 440-480 nm Green – 519-539 nm
LED Viewing Angle	30°
LED Pixel Brightness	12,400 cd/m^2 minimum white brightness
Pixel Pitch	20 mm

2.2.1. **Physical Characteristics.**

2.2.1.1. **General Construction.** Equipment design and construction must use the latest available techniques with a minimum number of different parts, subassemblies, circuits, cards, and modules to maximize standardization and commonalty. The equipment should be designed for ease of maintenance. All component parts must be readily accessible for inspection and maintenance. Test points must be provided for checking essential voltages.

Securely clamp cables in sign housings with cable attachments. Do not use adhesive attachments.

Ensure performance of the signs will not be impaired due to continuous vibration caused by wind, traffic, or other factors. This includes the visibility and legibility of the display.

Ensure the presence of power transients or electromagnetic fields, including those created by any components of the system, will have no deleterious effect on the performance of the system. Ensure the system does not conduct or radiate signals, which will adversely affect other electrical or electronic equipment including, but not limited to, other control systems, data processing equipment, audio, radio, and industrial equipment.

2.2.1.2. **Lift-Face Housing.** The lift-face housing dimensions and total sign weight not to exceed 1,500 lb. will be as shown in the VMS Manufacturer's specification or on the plans.

The sign housing skin will be constructed of aluminum alloy 5052-H32 which must not be less than 1/8" thick, unless otherwise specified in this document. Framing structural members must be made of aluminum alloy 6061-T6.

The equipment within the sign housing should be protected from moisture, dust, dirt, and corrosion. The lift-face housing must meet NEMA 3R enclosure criteria as defined in NEMA Standards Publication 250, "Enclosures for Electrical Equipment (1000 Volts Maximum.)"

To prevent open doors from blowing in wind, they must have a retaining latch mechanism to hold the door open at a 90° angle.

Design the sign and attached support elements to withstand design wind loads without permanent deformation. All sign types and attached support elements will be designed to withstand a 3-sec. gust Basic Wind Speed of 140 mph, a gust factor of 1.14, and the AASHTO specified wind importance factor for the 50-yr. mean recurrence interval for non-hurricane regions of 1.0 (in accordance with the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals, 6th Edition (2013.)) Front face will have black finish with an outdoor service life of 20 yr. Sign face will provide a high-contrast appearance for the display. Mask (if used) will contain an opening for each pixel.

There will be no exposed fasteners or welds on the housing face.

The bottom panel of the housing must have a minimum of four drain holes, with snap-in, drain filter plug inserts, in each section formed by internal structural members. Water drain filter plug inserts will be replaceable. Weep holes and ventilation or exhaust hoods must be screened to prevent the entrance of insects and small animals.

The housing must be designed to accommodate mounting on the rear vertical plane.

2.2.1.3. Surface Finish. The face (lens panel aluminum mask) will be finished with a matte-black, licensed-factory-applied, KYNAR 500 Resin, fluropolymer-based coating system or coated with semi-gloss black polyvinylidene fluoride (PVDF) applied in accordance to American Architectural Manufacturers Association (AAMA 2605.) The face should be uniform in appearance and completely free from distortion, gouges, and any other flaws or defects. A certification must be required from the licensed-factory KYNAR 500 coater for all aluminum face materials.

All other exterior surfaces will be a natural aluminum mill finish. No painted surfaces will be allowed.

All interior surfaces will be a natural aluminum mill finish.

2.2.1.4. Exterior Skin. The exterior skin of the housing will be 5052-H32 aluminum alloy sheet 0.125 in. minimum thickness.

The number of seams should be kept to a minimum. All exterior seams and joints must be sealed to form a rain and weather tight enclosure.

The skin material must be stitch welded to the internal structural members to form a unitized structure.

2.2.1.5. Mounting. The exterior mounting assemblies must be 6061-T6 aluminum alloy extrusions, 3/16-in. minimum thickness.

2.2.1.6. Lens Panel Assembly. The Lens Panel Assembly must consist of a KYNAR 500 coated aluminum mask over a clear glazing. The aluminum mask must be laminated and sealed to the surface of the glazing using the 3M Scotch VHB joining system or pre-approved equivalent.

2.2.1.7. Lens Panel Aluminum Mask. The Lens Panel Aluminum Mask will be:

- 0.063 in. minimum thickness;
- finished with a matte-black, licensed-factory-applied, KYNAR 500 Resin, fluropolymer-based coating system; and
- perforated to provide an aperture for each pixel on the display modules. Each aperture should be as small as possible without blocking the LED light output at the required viewing angle.

2.2.1.8. **Sign Display.** The face panel clear glazing (if used) should be 90% UV opaque, non-breakable, polycarbonate, or equivalent, minimum 1/8 in. thick, and clear in color. Laminate and seal the glazing to the inside surface of the lens panel.

The sign face must not be subject to fogging, frost, and condensation. If an automatically controlled system is used to keep the front face panel free of fog, frost, and condensation, provide ability for monitoring and control by the sign controller. Heat generated by the system should not damage any part of the VMS.

2.2.2. **Environmental Control.**

2.2.2.1. **Ventilation.** The ventilation system must be a positive-pressure, filtered, forced-air system which cools both the display modules and the sign housing interior. Signs with negative pressure systems that use exhaust fans are not acceptable.

The ventilation system must provide a minimum of 2 sign housing volume air changes per minute at the pressure drop developed throughout the entire ventilation system.

The inlet and exhaust filters must be electrostatic and must be sized to properly accommodate the air flow and pressure drop requirements of the ventilation system. Filters should be easily removable from within the sign housing without the use of tools. Both inlet and exhaust must use environment-friendly, washable, and reusable electrostatic filters.

The VMS will contain an electronically controlled ventilation system and a failsafe thermostat to keep the internal VMS air temperature lower than +60°C, when the ambient outdoor temperature is +46°C. There must be a minimum of one sensor located near the middle of the sign housing interior. There must be an additional temperature sensor located to accurately measure the ambient temperature outside the sign housing. The temperature sensors should have an accuracy of +/- 1.5°C and a range from -40° to +74°C.

The temperatures from the sensors must be continuously measured and monitored by the sign controller. A temperature reading greater than a user selectable critical temperature should cause the sign to go to blank and the sign controller must report this action to the central controller. This user selectable critical temperature must be capable of being changed by the central controller or laptop computer. The central controller and laptop computers should have the ability to read temperature measurements from the sign controller.

The LED modules and electronic equipment must be protected by a fail-safe, back-up fan control system in the event of an electronic fan control failure or shutdown of the sign controller. The housing must be equipped with a thermally-controlled back-up system that will activate the ventilation system automatically if the temperature inside the housing exceeds a pre-set limit.

2.2.2.2. **Temperature and Humidity.** Provide signs and associated field electronics that satisfy at a minimum Section 2.1.5 "TEMPERATURE AND HUMIDITY" of the NEMA TS 4, latest revision.

The enclosed housing with fans must meet the following requirements:

- provide positive air ventilation system with intake fans;
- fans with permanently lubricated ball or roller bearings;
- fans must allow user configured on- and off-temperature settings; and
- adequate air flow should be automatically tested once per day from Lonestar™. Inadequate air flow will cause an error message to be sent to the central control software.

2.3. **Optical and Electrical Requirements.**

2.3.1. **LED and Pixel Characteristics.** The LEDs should be AlInGaP or INGaN, Precision Optical Performance T 1-3/4 diodes. The LEDs must be rated for 100,000 hr. continuous operation while maintaining a minimum of 50% of the original brightness or less than 30% lumen depreciation. The LEDs will have standoffs that hold the base of the LEDs off the printed circuit board to promote cooling of the LEDs. Through-hole LEDs

mounted flush to the printed circuit board are not acceptable. Surface-mount LEDs are not acceptable. The LED brightness and color bins that are used in each pixel will be provided to the engineer for approval. Certification must be provided, with the submittals, from the LED manufacturer that demonstrates that the LEDs were tested.

The LEDs in each pixel must be clustered to maximize long range visibility. All pixels will have equal color and on-axis intensity. All pixels in all signs in this project, including the spare parts, will have equal color and on-axis intensity. The method used to provide the equal color and intensity, as stated above, must be included in the submittals and approved.

The pixel strings should be powered from a regulated DC power source and the LED current must be maintained at a current level to maximize life of the pixel. The failure of an LED in one string within a pixel should not affect the operation of any other string or pixel.

The LEDs must be individually mounted directly to a printed circuit board and should be easily replaceable and individually removable using conventional, electronic repair methods.

2.3.2. Display Module and Driver Boards. Each display module consists of a display board with a matrix of LED pixels. The pixels are mounted on the front side of the display module.

The driver board connects to the sign interface circuits and passes information to the associated display modules, which control the character pixels. The driver board must receive control signals and display data from the sign controller. The display module must contain the control and memory elements and provide the signals to switch and read the LED pixels.

The driver boards must connect to a single control cable common to each line of display modules.

The LED display board must contain all LEDs required to form a matrix of pixels. Pixels should be arranged uniformly to display a dot-matrix character of the desired height and width. The height of a standard character will be defined as the distance from the lowest point of the lowermost pixel of the character to the highest point of the uppermost pixel of the character. Smaller characters are not acceptable.

The display modules should be rectangular and have an identical horizontal and vertical pitch between pixels.

The separation between the last column of one module and the first column of the next should be equal to the horizontal distance between the columns of a single display module.

The separation between the last row of one module and the first row of the next must be equal to the horizontal distance between the rows of a single display module.

All LEDs must be individually and directly mounted to the LED circuit board to form the LED display board. The LED display board should support the driver board.

All LEDs must be mounted so that their mechanical axis is normal +/- 1.00° to the face of the sign to ensure brightness uniformity over the face of the sign.

Design modules, such that failure of one or more pixels, does not affect the operation of other pixels. Ensure failure of any module does not affect the operation of other modules.

Conformal coat Printed Circuit Boards (PCB) with a minimum 0.005 in. (5 mil) thick silicone resin or acrylic resin conformal coat. Use coating material that complies with military specification MIL-I-46058C Type SR and IPC-CC-830.

Each LED driver board will be microprocessor-controlled and will communicate with the sign controller on a wire or fiber optic communication network using an addressable network protocol. The microprocessor will

process commands from the sign controller to display data, perform diagnostic tests, and report pixel and diagnostic status.

2.3.3. Display Assembly. Each display module must include an LED display circuit board. A single data exchange and addressing cable must connect the driver board to the LED boards it controls that are not directly attached to the driver board. The driver board must contain the solid-state electronics necessary to control pixel data and read pixel status.

All LED boards and driver boards should be fully interchangeable and must not require any manual addressing switches or adjustment when interchanged or placed in service.

The display modules must be mounted to the display face in a manner that facilitates easy and rapid removal of each display module without disturbing adjacent display modules. Replacement of a complete display module should be possible without the use of any tools.

2.3.4. Legibility. The characters should be legible under all light conditions at a distance of 350 ft. within the degree cone of vision centered around the optical axis of the pixel. The cone perimeter will be defined by its 50% intensity points.

The sign must be the proper brightness in all lighting conditions for optimum legibility.

It must be bright enough to have a good target value, but not to the point where the pixels bloom, especially in low ambient light level conditions.

The brightness and color of each pixel should be uniform over the entire face of the sign within the cone of vision from 350 ft. to 50 ft. in all lighting conditions. Non-uniformity of brightness or color over the face of the sign under these conditions will be cause for rejection of the sign.

The sign and its controller must meet a minimum Section 8.8 "BRIGHTNESS CONTROLS" of the NEMA TS 4, latest revision. The controller should monitor and self-adjust the brightness of the display. Ensure brightness is manually and automatically adjustable from the local sign controller. Enable brightness control to be set to specific levels from the sign controller (local,) laptop (remote,) and Lonestar™ (central) software.

2.3.5. Characters Displayed. The signs must be capable of displaying ASCII characters 32 through 126 (including all upper and lower-case letters and digits from 0 to 9) at any location in a message line. If shown on the plans, a special graphics character should be substituted for any of these characters.

The sign should normally display double stroke (11 X 7) characters with triple-column spacing between characters. The spacing options should be one, two, or three pixel columns. Each font may be edited and downloaded to the sign controller from the central controller or laptop computer at any time without any software or hardware modifications.

The sign must have the capability to display automatically-scaled character fonts applied to a given message to maximize the font size of the displayed text, up to the full height of the display for a single line of text.

Full matrix VMS capable of displaying 3 rows of 18 in. tall characters, displaying 8 characters on each row. Color sign with a minimum of 224 pixel columns and 96 pixel rows. Pixel pitch must be 20 mm.

2.3.6. LED DC Power. The voltage to the LED modules and associated electronics must not exceed 25 VDC. The power supplies should have a minimum efficiency of 85% with a minimum power factor rating of 0.95.

The power supplies will be wired in a redundant configuration, that uses multiple supplies for the display matrix or paralleled in a diode OR configuration and supply enough power to run 100% of all pixels at 100% duty cycle. Functioning supplies must current-share to within 10%.

The power supplies used to power the LED pixel modules must be identical and interchangeable throughout the VMS.

Power supplies will be UL listed and have an application of coating to protect from the environmental elements.

2.3.7. Photoelectric Sensor Devices. Three photocells must be installed in the sign. These devices should permit automatic light intensity measurement of light conditions at each sign location. These photocells must be mounted in a manner to measure front, rear, and ambient light conditions.

Automatic adjustment of the LED brightness should occur in small enough increments so that the brightness of the sign changes smoothly, with no perceivable brightness change between adjacent levels. Provision must be made to prevent perceivable brightening of the sign due to stray headlights shining upon the photo sensors at night.

There should be a means to adjust how rapidly the sign responds to changes in ambient light as measured by the photocells. This can be used, for example, to prevent the sign from changing its brightness due to a vehicle's headlight momentarily shining on the sign. The adjustment must be made from the central controller or laptop computer and should have two different settings, one for daytime control and one for nighttime control, with the day or night ambient light threshold also being an adjustable value. In addition, there should be a means to specify different weighting factors for each photocell, to specify how prominently each photocell figures in the calculation of nighttime ambient light.

2.3.8. Power. The sign and its sign controller must be capable of operating with 120/240 VAC, 20 A per leg maximum, 60 Hz, single-phase power. The sign controller cabinet must be capable of distributing power to 2 separate VMS's.

Inside the sign housing, all 120 VAC service lines must be independently protected by a thermo magnetic circuit breaker at the sign housing entry point. All 120 VAC wiring must be located in conduit, pull boxes, raceways, or control cabinets as required by the latest version of the National Electric Code (NEC). No 120 VAC wiring must be exposed to the inside or outside of the sign housing. The sign housing should not be considered as a raceway or control cabinet.

The presence of power transients or electromagnetic fields, including those created by any components of the system, will have no deleterious effect on the performance of the system. The system must not conduct or radiate signals which will adversely affect other electrical or electronic equipment including, but not limited to, other control systems, data processing equipment, audio, radio, and industrial equipment.

The system power and communication lines should be protected by transient voltage suppression devices including MOVS and spark gap arrestor.

The efficiency of the power supply must be 80% or greater when operated at 50% to 100% of maximum load. The power supply should have a power factor of 0.95 or greater at operating voltage from 50% to 100% of maximum load.

A minimum of 2 power supplies must be provided for redundancy. Power supplies should be designed such that if one supply fails, the remaining supply must be able to operate 100% of the pixels at full brightness. Supply 50%, 80%, and 100% full-load calculations for Volt-Amps-Reactive (VARs) and Volt-Amps (VA) loads consumed by VMS sign, operating at 120 VAC.

The sign controller must monitor and report to Lonestar™ the output voltage and functional status of regulated Direct-Current (DC) power supplies located in the VMS by monitoring diagnostic outputs located on these power supplies.

Ensure GFCI devices protect all service outlets. At a minimum, there should be one duplex outlet inside the cabinet.

Ensure AC cables are type Cross-Linked High Heat Water (XHHW) and sized as required by the NEC.

The sign housing must have one earth ground lug that is electrically bonded and located near the power entrance location on the sign housing.

All earth grounding will conform to the National Electric Code.

2.3.9. **Transients.** The equipment will meet the performance requirements specified in Section 2.1.4 of the NEMA standard TS4.

2.4. **Field Equipment Cabinet.** With each VMS, furnish one ground mount cabinet configuration as specified on the plans. Furnish cabinet meeting minimum materials and construction requirements of Special Specifications Item, "Intelligent Transportation Systems (ITS) Ground Mounted Cabinet" (applicable to cabinet only) with additional features described herein.

Provide the following items in the field equipment cabinet:

- power-on indicator;
- room for communication devices (shelf mounted and rack-mounted switches, modems, terminal servers;)
- local or remote switch and LED indicator;
- alarm switch when the cabinet has been opened and capable of communicating with Lonestar™;
- provide a full-height standard EIA 19-inch rack. The rack must be secured within the cabinet by mounts at the top and bottom;
- provide a minimum of one empty pull out drawer. Ensure drawer is capable of supporting a 20 lb. load; and
- provide outdoor rated markings and identification on the power protection panel.

2.5. **Sign Controller.** Provide a sign controller with resident software and the capability of operating up to 2 VMS's. Ensure controller has a what-you-see-is-what-you-get (WYSIWYG) LCD display, representing the message being displayed. Perform all communication, control, and feedback functions for the VMS through the local sign controller. Ensure sign controller supports all Lonestar™ software functionality.

Include a front panel user interface with graphical LCD or keypad for direct operation and diagnostics as described herein (keypad not needed for touchscreen interface.)

Send and receive messages from the sign controller through the communication demarcation point in cabinet via the communications port housed in the field equipment cabinet. Furnishing and installation of communications and power cables from the cabinet to the utility service or the communications demark is described in Special Specification "Installation of Dynamic Message Sign System."

The controller will have power-up and auto-restart capabilities with a programmable default message (including a blank message) when recovering from a power off condition. A hardware watch dog circuit will be used to provide automatic reset to the controller and the modem. The central computer must be capable of remotely commanding a controller and modem reset.

The sign controller must be capable of being controlled from the central controller or the laptop computer.

2.5.1. **Modes of Operation.** Ensure the modes of operation are consistent with those defined in NTCIP, specifically Local, Central, and Central Override.

Ensure the sign controller can monitor individual sensors status. Controller must be able to pass sensor information to Lonestar™ such as Power Status Data, Temperature Sensor Data, and Light Sensor Data as defined in NTCIP 1203. The controller must have cabinet door-open sensor and report back door-open status to Lonestar™.

In the event of a communications failure with the VMS central control software, the local sign controller sets the sign to blank, all pixels off, after a user-defined number of minutes unless communications are restored within this period.

The local sign controller must be remotely resettable from the central control software.

During any time the controller is in reset or bootup condition, the message should be in neutral state (default, blank, all pixels off.)

VMS sign controller should support the storage and use of a minimum of 255 TMUTCD graphics which can be formatted and displayed.

2.6. Communication

2.6.1. **Ports for Remote Communication.** Controller must provide a minimum of 1 Ethernet port with RJ45 connector.

2.6.2. **Ports for Local Communication.** Controller must provide a minimum of 2 Ethernet ports with RJ45 connector to operate up to 2 VMS's.

2.6.3. **Protocols.** The communications ports, for the sign, will act in accordance with all commands defined in Section 8-.10-7 "NTCIP PROTOCOL AND COMMAND SETS" of the NEMA TS 4, latest version. Ensure the communications ports, for the sign, act in accordance with all TxDOT NTCIP user defined commands.

2.6.4 **Communication Interface.** The sign controller must include separate serial interfaces for communication with the central controller and the laptop computer.

The communications between the sign controller and the central controller or laptop computer should comply with the National Transportation Communications for ITS Protocol (NTCIP). Unless otherwise stated, the software will comply with the versions of the relevant NTCIP standards that are current at the date of this document.

In addition to the standard MIB objects, the sign should include any additional manufacturer-specific MIB objects required to support all of the sign and central software functionality defined elsewhere in this specification.

2.7. Clock and Timer

2.7.1. **Internal Clock.** Internal Clock will be backed up with a non-battery device such as a large capacitor (super capacitor) for a minimum of 168 hours and ensure the correct messages are displayed at the correct time, even in the event of a communications loss.

2.7.2. **Watchdog.** When polled by Lonestar™ the local sign controller will submit a status report to the central control software when a watchdog event has occurred, including the current sign status and must wait in a Neutral state until further instructions are sent from the statewide central control software, or until manually reset by local control.

2.8. **Initial Documentation.** Before sign manufacturing, provide VMS manufacturer's documentation for each sign type. Document should include each applicable equipment item or component in a searchable PDF manual and submit it for approval. Provide electronic copies of the manual and a minimum of one paper copy of the manual for each sign delivered. Ensure that VMS manufacturer's manual includes the following.

- Independent laboratory test reports explaining testing process and verification worksheet displaying NEMA TS 4 compliance.
- Verification of NTCIP Compliance. The Department will verify, through use of the Department's NTCIP Tester, that the equipment complies with the requirements of NTCIP 1101 Simple Transportation Management Framework; NTCIP 2101, Subnet Profile for PMPP.

- The vendor must submit documentation of successful software compliance testing with TxDOT's Lonestar™ VMS subsystem, latest version. Maintenance software will be provided by the vendor to the Department at no cost to the Department. This software should allow fonts to be added or changed by the Department.
- Documented testing procedures (see section 3.5.)
- VMS shop drawings.
- Power load requirements (for Sign and for the Controller Cabinet) and communications cabling pinouts for cables run between the Cabinet and VMS sign (as per Special Specification "Installation of Dynamic Message Sign System.")
- Complete and accurate schematic diagrams including circuit board schematics.
- Complete and accurate cabinet, enclosure, and building wiring diagrams.
- Complete installation procedures.
- Complete performance specifications (functional, electrical, mechanical, and environmental) on the unit.
- Complete parts list including names of vendors for parts not identified by universal part numbers such as JEDEC, RETMA, or EIA.
- Pictorial of component layout on circuit board.
- Complete stage-by-stage explanation of circuit theory and operation.
- Complete and detailed system operations manuals.
- Data necessary for isolation and repair of failures or malfunctions, assuming the maintenance technicians to be capable of analytical reasoning using the information provided in above subsection. Describe accuracy, limits, and tolerances for all electrical, physical, or other applicable measurements. Include general instructions for disassembly, overhaul, and reassemble, including shop specifications or performance requirements.
- Detailed instructions where failure to follow special procedures would result in damage to the equipment, improper operation, or danger to operating or maintenance personnel. Such instructions and specifications should be included only for such maintenance as may be accomplished by specialized technicians and engineers in a modern Electro mechanical shop. Describe special test setup, component fabrication, and the use of special tools, jigs, and test equipment.
- A detailed physical description of size, weight, special mounting requirements, electrical connections, power requirements, and all other pertinent information necessary for proper installation and use of the equipment. Ensure the vendor works with contractor to submit sign supports and support brackets, and shop drawings compliant with Special Specification " Dynamic Message Sign System."
- Periodic maintenance schedule.
- A list of certified maintenance personnel, including qualifications, experience, and applicable certifications of individuals who may be performing maintenance on products as required by this specification.

3. CONSTRUCTION

3.1. **General.** Install contractor-furnished color VMS according to the manufacturer's recommendations and in accordance to Special Specification "Installation of Dynamic Message Sign System." Ensure installation and configuration of software on Department computers is included with the color VMS.

3.2. **Requirements for Shop Drawings.** Submit shop drawings in Microstation DGN and PDF format for approval before fabrication; include the sign structural members and attachment supports in accordance with Standard Specification Item 5 Article 5.2 " Plans and Working Drawings." Shop drawings must be sealed by a licensed professional engineer (Licensed in the U.S.)

3.3. **Delivery.** Deliver sign and cabinet to location determined by the Department, including removing sign from delivery truck onto ground. The Department will not provide any crane equipment to lift sign off of truck. Must provide equipment to lift. The Department will not be held liable for any damages incurred during shipment,

including lifting the sign from delivery truck onto ground. Delivery will not be complete until sign has been unloaded onto ground, secured to prevent tipping, and passed the demonstration test.

3.3.1. **Final Documentation**. Provide as-built final documentation for approval reflecting all field changes and software modifications. Include detailed drawings of conduit layouts, cable diagrams, wiring lists, cabinet layouts, wiring diagrams, and schematics for all elements of the communications system. Include the cable type, color code, and function, the routing of all conductors' pairs in the cable diagrams and wiring lists.

Provide manufacturer's software, documentation, and intellectual property rights for the computer software system and components. These must include, but are not limited to, the following.

- **Deliver**. One copy of all documentation supplied by the manufacturers for all plug-in circuit cards used in the microcomputer chassis.
- **License**. Grant the department a non-exclusive unrestricted license that will allow the Department to use, modify, or distribute any or all of the stated communication protocols and documentation.
- **Technical Assistance**. Include instructions for troubleshooting and warranty replacements.

3.4. **Testing**. Ensure that the Department receives a sign capable of complying with the following test procedures which will be performed upon delivery of the Color VMS to the contractor's yard and again at installation of the Color VMS on the support structure as located on the plans.

3.4.1. **Examination of Product**. Contractor will examine each unit carefully to verify that the materials, design, construction, markings, and workmanship comply with the requirements of the parent specification. Department may also verify that the Color VMS furnished by the Contractor meets specification.

3.4.2. **Continuity Tests**. Department may check the wiring to determine conformance with the requirements.

3.4.3. **Operational Test**. Contractor will operate each unit for 2 hr. to permit equipment temperature stabilization and an adequate number of performance characteristics to ensure compliance with the requirements.

3.4.4. **Pixel Status Tests**. Contractor will conduct pixel status tests to ensure the pixels are fully functional. Ensure that Vendor must provide detection for out-of-service LED pixels through testing procedures conducted through the sign controller. When polled, controller must be required to report results to Lonestar™ VMS central software.

- **Pixel Test**. Sign must be capable of a full operational status of each pixel and report of the status to the local sign controller. Upon request from Lonestar™ software, sign should identify a list of modules with defective pixels. The pixel test may briefly disturb the displayed message for no more than 0.5 sec.
- **Pixel Read**. Sign must be capable of reporting back to the local controller which pixels are on or off. Upon request from Lonestar™ software, sign should provide a list of which pixels are on or off. Pixel read should not interfere the displayed message.

3.4.5. **VMS Testing Procedures**. Contractor must coordinate with the Vendor to be present during all testing. Contractor will submit Manufacturer-approved test procedures and worksheets detailing the following tests to ensure VMS meets all specifications defined:

- initial demonstration, and
- stand-alone.

Contractor will ensure that Vendor representative will perform both tests at location determined by the Department.

3.5. **Maintenance**. Ensure that the installed color VMS has a manufacturer's maintenance plan covering: Vendor must perform periodic maintenance during the warranty period as follows.

3.5.1. Vendor must submit a recommended periodic maintenance schedule for the review by the Department.

3.5.2. Vendor should have a maintenance representative located within the state of Texas. Visits by the representative to various locations identified by the Department will be required. Representative will be notified by telephone at the location and telephone number designated by the vendor as the point of contact for any repair work. Vendor must notify the Department immediately of any changes in this location and telephone number. Maintenance representative must possess and maintain an inventory of common replacement parts.

3.5.3. Vendor must perform periodic maintenance tests 4 times per year during the warranty period at no additional cost to the Department. This periodic maintenance may be performed remotely. Provide documentation to TxDOT.

3.5.4. Vendor must perform periodic VMS equipment maintenance on-site at intervals not exceeding 12 months. The vendor will be responsible for all costs related to this requirement, including but not limited to the following: travel, per diem, labor, material, equipment, on-site labor, on-site material, on-site equipment, and access to the signs. The vendor must satisfy TMUTCD for temporary traffic control requirements and must obtain approval from the Department.

3.5.5. Vendor will provide to the Department a quarterly report of activities performed, in an electronic spreadsheet format. This report must include all activities performed, equipment serviced, dates, and names of technicians who performed the maintenance. The report must include both periodic maintenance activities as well as warranty repair work, independently categorized. Include a list of all trouble calls, with time and date received, and time and date responded, including technician.

Minor items such as pixel outages which do not significantly affect sign operation can be scheduled for future repair not subject to the 72 hr. requirement.

3.6. Training. Provide manufacturer approved end user training to the Department and their representatives. Provide a minimum of 2 days of instruction in the operation and maintenance procedures. Train a maximum of 10 Department designated personnel.

Training will cover at minimum but is not limited to:

- hands-on operation of the sign;
- explanation of any system commands, their function, and usage;
- required preventative maintenance procedures;
- equipment servicing procedures;
- sign troubleshooting and problem identification procedures; and
- use of Diagnostic software.

Furnish a manufacturer approved training session agenda, a complete set of manufacturer approved training materials. Provide one copy of the course material for each person. The training room will be provided by the Department.

3.7. Warranty. Ensure that the installed color VMS has a manufacturer's warranty covering:
Materials will be warranted for 5 years from accepted installation date. The accepted installation date is defined as the date the Department determines the sign has passed installed testing requirements. The warranty will cover all defects in material, design, and workmanship, and will cover 100% parts and labor for repair work, including diagnostics. If the vendor standard warranty period exceeds 72 months, with a minimum of 60 months from accepted installation date, then the standard warranty period will be in effect. The vendor will submit in writing the terms of warranty.

During the warranty period the vendor will be responsible for labor, materials, shipping, traffic control, and other costs as outlined below for required warranty repair. It is the intent of this warranty that the vendor performs warranty repair work. At the Department's option, the Department may perform minor warranty repairs at the vendor's expense without voiding the warranty.

All diagnostics, testing, and replacements necessary to resolve any problems will be assumed by the vendor at no cost to the Department.

3.7.1. **Repairs.** The maintenance representative must respond within next business day and be available for warranty repairs and performance of services within 72 hr. of notification by the Department throughout the duration of the Warranty. Failure to meet this requirement may result in the Department billing the vendor for repair work performed by the Department or through a 3rd party without voiding the Warranty. Document all repairs within the quarterly report of activities.

3.7.2. **Exclusions.** The Department will assume the expense for replacement of knocked down cabinets, support structures, and other minor items resulting from day to day operations. The Department will assume responsibility for cost of repairs resulting from collision, theft, vandalism, or acts of God.

If vendor arrives at location for diagnostics or repair and TxDOT subsequently determines an exclusion, then TxDOT will assume responsibility for vendor's time and travel costs.

3.7.3. **Warranty Repairs by the Department.** The vendor performs all warranty repairs; however, at the Department's option, warranty repairs deemed by the Department to be minor in nature or due to vendor's failure to respond within 72 hr. of notification may be performed by the Department at the vendor's expense. Parts required for repairs made by the Department will be obtained from the vendor at no cost to the Department. The Department may request reimbursement for additional time incurred such as technician's travel time or diagnostic time. Reimbursement by the vendor to the Department for the cost of warranty repairs must be computed as follows.

3.7.3.1. **Labor:** Labor for warranty repairs will be calculated including travel to field locations, configuring devices, and running diagnostics on field device and communications equipment.

3.7.3.2. **Warranty Repair Claims:** Warranty repairs will be accumulated on Department Repair Orders and will be billed from same, unless the vendor prefers to have claims processed on the vendor's standard forms.

3.7.3.3. **Parts:** Replaced parts will be held 30 calendar days and will be available for inspection by the vendor or authorized representative. Copies of invoices for all parts will be provided to the vendor. The cost of parts other than those furnished to the Department at no cost by the vendor will be billed at actual cost.

3.7.3.4. **Billing and Payment for Warranty Repair Expenses:** Costs for minor warranty repairs will be accumulated, including labor, diagnosis time, and replacement parts (if not provided.) Reimbursement payment should be made within 30 calendar days of the billing date. The warranty must be in accordance with the Special Specification, "Testing, Training, Documentation, Final Acceptance, and Warranty."

4. MEASUREMENT

This Item will be measured as each unit furnished, installed, made fully operational, and tested in accordance with this Special Specification.

5. PAYMENT

The work performed and materials furnished, in accordance with this Item and measured as provided under "Measurement," will be paid for at the unit price bid for "Variable Message System (VMS) with Foundation Mounted Cabinet" or "Variable Message System (VMS) without Cabinet." This price is full compensation for furnishing, transportation, and installation of VMS and its equipment cabinet; furnishing and installing any new mounting hardware and VMS controller cabinet foundation when required; storing the VMS when required; cleaning and testing the VMS; replacement or repair of damaged components; disposal of unsalvageable material and for all manipulations, labor, tools, working drawings, equipment, and incidentals. This price is full compensation for furnishing, placing, and testing all materials and equipment, and for all tools, labor, equipment, hardware, operational software packages, communication cable and media

converters (if required,) supplies, support, personnel training, shop drawings, documentation, and incidentals.

New overhead sign supports or relocation of existing overhead sign supports will be paid for under Item 650, "Overhead Sign Supports." New drilled shaft foundations will be paid for under Item 416, "Drilled Shaft Foundations." New electrical conductors for power distribution will be paid for under Item 620 "Electrical Conductors."

Special Specification 6438

Mobile Retroreflectivity Data Collection for Pavement Markings

1. DESCRIPTION

Furnish mobile retroreflectivity data collection (MRDC) for pavement markings on roadways as shown on the plans or as designated by the Engineer. Conduct MRDC on dry pavement only. Provider is defined as the Contractor or Subcontractor who collects the MRDC data.

2. EQUIPMENT AND PERSONNEL

2.1. **Mobile Retroreflectometer**. Provide a self-propelled, mobile retroreflectometer certified by the Texas A&M Transportation Institute (TTI) Mobile Retroreflectometer Certification Program.

2.2. **Portable Retroreflectometer**. Provide a portable retroreflectometer that uses 30-meter geometry meeting the requirements described in ASTM E 1710. Maintain, service, and calibrate all portable retroreflectometers according to the manufacturer's instructions.

2.3. **Operating Personnel for Mobile Retroreflectometer**. Provide all personnel required to operate the mobile retroreflectometer and portable retroreflectometer. Ensure MRDC system operator has a current certification from the TTI Mobile Retroreflectometer Certification Program to conduct MRDC with the certified mobile retroreflectometer provided.

2.4. **Additional Personnel**. Provide any other personnel necessary to compile, evaluate, and submit MRDC.

2.5. **Safety Equipment**. Supply and operate all required safety equipment to perform this service.

3. MRDC DOCUMENTATION AND TESTING

Document all MRDC by county and roadway or as directed by the Engineer. Submit all data to the Department and to the TTI Mobile Retroreflectometer Certification Program no later than three working days after the day the data is collected. Submit all raw data collected in addition to all other data submitted. Provide data files in Microsoft Excel format or a format approved by the Engineer. Provide measurement notification and field tests as specified. Verification and referee testing may be conducted at the Department's discretion.

3.1. **Preliminary Documentation Sample**. Submit a sample data file, video, and map of MRDC data in the required format 10 working days before beginning any work. The format must meet specification and be approved by the Engineer before any work may begin.

3.2. **Initial Documentation Review and Approval**. The Department will review documentation submitted for the first day of MRDC, and if it does not meet specification requirements, will not allow further MRDC until deficiencies are corrected. The Department will inform the Provider no later than three working days after submittal if the first day of MRDC does not meet specification requirements. Time charges will continue unless otherwise directed by the Engineer.

3.3. **Data File**. Provide data files with the following:

- date;
- district number;

- county;
- Project CSJ number;
- name of mobile retroreflectometer operator;
- route number with reference markers or other reference information provided by the Engineer to indicate the location of beginning and end data collection points on that roadway;
- cardinal direction;
- line type (single solid, single broken, double solid, etc.);
- line color;
- file name corresponding to video;
- data for each centerline listed separately;
- average reading taken for each 0.1-mi. interval (or interval designated by the Engineer);
- accurate GPS coordinates (within 20 ft.) for each interval;
- color-coding for each interval indicating passing or failing, unless otherwise directed by the Engineer (passing and failing thresholds provided by the Engineer);
- graphical representation of the MRDC (y-axis showing retroreflectivity and x-axis showing intervals) corresponding with each data file;
- distance in miles driven while measuring the pavement markings;
- event codes (pre-approved by the Engineer) indicating problems with measurement;
- portable retroreflectometer field check average reading and corresponding mobile average reading for that interval when applicable; and
- upper validation threshold (may be included separately with the raw data but must be clearly identified with the data collected using that threshold).

3.4. **Map**. Provide a map in an electronic format approved by the Engineer with each MRDC submission that includes the following information:

- date;
- district number;
- county;
- color-coded 1-mi. intervals (or interval length designated by the Engineer) for passing and failing retroreflectivity values or retroreflectivity threshold values provided by the Engineer; and
- percentage of passing and failing intervals, if required by the Engineer.

3.5. **Video**. Provide a high-quality DVD or electronic video file with the following information:

- date and corresponding data file name on label;
- district number;
- county;
- route number with reference markers or other designated reference information to indicate the location of beginning and end collection points on that roadway; and
- retroreflectivity values presented on the same screen with the following information:
  - date;
  - location;
  - starting and ending mileage;
  - total miles;
  - retroreflectivity readings; and
  - upper validation thresholds (may be included separately with the raw data but must be clearly identified with the data collected using that threshold).

3.6. **Field Comparison Checks with a Portable Retroreflectometer**. Take a set of field comparison readings with the portable retroreflectometer at least once every 4 hr. while conducting MRDC or at the frequency designated by the Engineer. Take a minimum of 20 readings, spread out over the interval measured. List the average portable retroreflectometer reading next to the mobile average reading for that interval with the

reported MRDC data. Request approval from the Engineer to take field comparison readings on a separate roadway, when measuring a roadway where portable retroreflectometer readings are difficult to take. Take the off-location field comparison readings at no additional cost. Submit the portable retroreflectometer printout of all the readings taken for the field comparison check with the corresponding MRDC data submitted. The mobile average reading must be within ±15% of the portable average reading. The Engineer may require new MRDC for some or all of the pavement markings measured in a 4-hr. interval before a field comparison check not meeting the ±15% range. Provide the new MRDC at no extra cost to the Department. The Engineer may take readings with a Department portable retroreflectometer to ensure accuracy at any time. The Department's Materials and Tests Division (MTD) will take comparison readings and serve as the referee if there is a significant difference between the Engineer's portable readings and the Provider's mobile and handheld readings. For best results, take field comparison readings on a fairly flat and straight roadway when possible.

3.7. **Periodic Field Checks at Pre-Measured Locations**. When requested by the Engineer, measure with the mobile unit and report to the Engineer immediately after measurement the average retroreflectivity values for a designated pre-measured test location. The Engineer will have taken measurements at the test location within 10 days of the test. The test location will not include pavement markings less than 30 days old. If the measured averages do not fall within ±15% of the pre-measured averages, further calibration and comparison measurements may be required before any further MRDC. Submit the results of the field check with the MRDC report for that day.

3.8. **Measurement Notification**. Provide notification via email to Mobileretro@tamu.edu with a carbon copy to the Engineer a minimum of 24 hr. before mobile retroreflectivity data collection to allow for scheduling verification testing when needed.

3.9. **Verification Testing.** The Engineer or a third party may perform retroreflectivity verification testing within seven days of the Provider's retroreflectivity readings. The Provider-submitted retroreflectivity data will be compared to the verification test data to determine acceptability of the Provider's mobile retroreflectometer data. Comparison of the data will result in one of the two scenarios below:

- Provider's Data is Validated – if the difference between Provider's and Engineer-third party data is 20% or less, then the Provider's data is validated. The Provider's data will be used for acceptance.

- Provider's Data is not Validated – if the difference between Provider's and Engineer-third party data is more than 20%, then the Provider's data is not validated. The Engineer-third party data will be used for acceptance and the Provider will be required to take corrective action before additional Provider data collection and may require re-certification of the mobile retroreflectometer. If the Engineer determines that the Provider's data might be correct then, referee testing may be requested by the Engineer.

3.10. **Referee Testing.** MTD will perform referee testing using portable retroreflectometers to determine if the markings need to be restriped to meet the required retroreflectivity level. The referee test results will be final. Referee testing will be conducted on the verification test sections using the method for portable retroreflectometers specified in Item 666, "Reflectorized Pavement Markings."

4. FINAL REPORT

Submit a final report in the format specified by the Engineer to the Department's Traffic Engineering representative within one calendar week after the service is complete. The final report must contain a list of all problems encountered (pre-approved event codes) and the locations where problems occurred during MRDC.

5. MEASUREMENT

When mobile retroreflectivity data collection for pavement markings is specified on the plans to be a pay item, measurement will be by the mile driven while measuring pavement markings.

6. PAYMENT

Unless otherwise specified on the plans, the work performed, materials furnished, equipment, labor, tools, and incidentals will not be paid for directly, but will be considered subsidiary to bid items of the Contract. When mobile retroreflectivity data collection for pavement markings is specified on the plans to be a pay item, the work performed in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Mobile Retroreflectivity Data Collection." This price is full compensation for providing summaries of readings to the Engineer, equipment calibration and prequalification, equipment, labor, tools, and incidentals.

Special Specification 6475
Hardened Ethernet Switch

1. DESCRIPTION

Furnish and install Hardened Ethernet Switch (HES) at designated locations as shown on the plans, as detailed in accordance with these Specifications, and as directed. Provide all HES from the same manufacturer.

2. MATERIALS

2.1. **General Requirements**. Provide all new equipment in strict accordance with the details shown on the plans and in the specifications.

Provide a high-performance, modular hardened Ethernet switch to support standard Ethernet, and Fast Ethernet connectivity. Ensure dedicated bandwidth to the desktop and guarantees that each end-user receives a full 10 or 100 Mbps connection, as configured, enabling applications to operate reliably, and with low latency.

Include licenses for all equipment, where required, for any software or hardware in the system.

2.2. **Adherence to Standards**. Furnish, assemble, fabricate, or install HES under this Item that is in compliance with the following:

- IEEE 802.3, 802.3u, 10BASE-T, 100BASE-TX, 100BASE-FX;
- Auto-sensing for speed: IEEE 802.3u; and
- UL, cUL, FCC and CE.

2.3. **Functional Requirements.**

2.3.1. **Physical Design Requirements.** Ensure HES physical design conforms to the following requirements:

- for HES Type 1, provide 2 built-in 100 MB full-duplex switched multi-mode fiber ports, coupled with 6 switched 10/100 MB copper (RJ 45) ports all in 1 compact rugged unit;
- for HES Type 2, provide 4 built-in 100 MB OR 1,000 full-duplex switched single-mode fiber ports, or combination built-in ports, or combo ports to achieve full-duplex switched single-mode fiber ports, coupled with minimum 6 switched 10/100 MB copper (RJ 45) ports all in 1 compact rugged unit;
- ensure daisy-chainable for a fiber optic Ethernet network;
- designed to operate in abnormal temperature applications, and are suitable for use in harsh environments with inhospitable high and low temperatures;
- ease to install and use. Addresses of attached nodes are automatically learned and maintained, adapting the switching services to network changes and expansions;
- ensure plug-and-play installation, and operation is transparent to software;
- ensure unit has high-strength, 18-gauge steel enclosure to seal out insects, dirt, smoke, and other contaminants. Ensure steel enclosure operates as heat sinks, drawing heat away from internal components; and
- identify clearly all modules and assemblies with name, model number, serial number, or any other pertinent information required to facilitate equipment maintenance.

2.3.2. **Electrical and Mechanical Requirements.** Provide the following functionality and features.

- Parts Performance:
  - fiber, and when an auto-negotiating port is operating at 100 Mbps: Data Rate: 100 Mbps, and
  - RJ-45 auto-negotiating port is operating at 10 Mbps: Data Rate: 10 Mbps.
- Packet-Processing Between Domains:
  - filtering and forwarding rate from 100 Mbps ports: 148,800 pps max,
  - filtering and forwarding rate from 10 Mbps ports: 14,880 pps max,
  - processing type: store and forward,
  - auto-learning: 16K address table, shared for all traffic domains,
  - packet buffers: 1.0 Mb, dynamically shared on all domains, and
  - latency (not include packet time): 100 to 10 Mbps and 10 to 100: < 15 microsecond.
- Path Delay Value: 50 BT on all ports.
- Network Cable Connectors:
  - six RJ-45 shielded female ports,
  - two fiber ports. For HES Type 1 provide multi-mode. For HES Type 2 provide single-mode,
  - 100 Mbps: Category 5 UTP/STP; Fiber: 62.5/125 micron multimode fiber with SC connectors for HES Type 1. (8.0-8.3)/125 micron singlemode fiber with SC connectors for HES Type 2, and
  - 10 Mbps: Category 3, 4, 5 UTP (Auto-sensing).
- Full-duplex or Half-duplex on copper (RJ-45) switched ports:
  - all the RJ-45 ports support full or half duplex and 10/100 speed, each independently auto-negotiating, and
  - the switched fiber ports must be fixed at full-duplex only, 100 MB speed.
- Mean Time Between Failure: > 10 yr.
- LED Indicators: 1 LED for power, 3 LEDs per port for speed, link activity, full- or half-duplex.
- Power Requirements: The Hardened Ethernet Switch furnished, assembled, fabricated, or installed under this Item must meet all of its specified requirements when the input power is 115 VAC ±10%, 60 ±3 Hz.
  - AC power connector: IEC-type, male recessed at rear of power supply chassis.
    Input Voltage: 85 to 260 VAC (auto-ranging).
    Input Frequency: 47 to 63 Hz (auto-ranging).
    Power Consumption: 15 watts typical.
    Power Supply Rating: 3 amps at 5 VDC.
    Input Fuse for overload and short protection: 3 AG type, 0.5 amp.
    Power Capacity: 15 watts output, 70% min efficiency.
    Surge Protection: Over 150 joules, with clamping at 800V 50A min.
    Operating Shock and Vibration: Meets Bellcore GR-63-Core Sections 4.4.1 and 4.4.3.

  Provide equipment operations that are not affected by the transient voltages, surges, and sags normally experienced on commercial power lines. Check the local power service to determine if any special design is needed for the equipment. The extra cost, if required, must be included in the bid of this Item.

  - Wiring: Provide wiring that meets the requirements of the National Electric Code. Provide wires that are cut to proper length before assembly. Provide cable slacks to facilitate removal and replacement of assemblies, panels, and modules. Do not double-back wire to take up slack. Lace wires neatly into cable with nylon lacing or plastic straps. Secure cables with clamps. Provide service loops at connections.
  - Transient Suppression: Provide DC relays, solenoids, and holding coils that have diodes or other protection devices across the coils for transient suppression.

- Power Service Protection: Provide equipment that contains readily accessible, manually resettable, or replaceable circuit protection devices (such as circuit breakers or fuses) for equipment and power source protection.

Provide and size circuit breakers or fuses such that no wire, component, connector, PC board, or assembly must be subjected to sustained current in excess of their respective design limits upon the failure of any single circuit element or wiring.

- Fail Safe Provision: Provide equipment that is designed such that the failures of the equipment must not cause the failure of any other unit of equipment.

3. CONSTRUCTION

3.1. **General.** Provide equipment that uses the latest available techniques for design and construction with a minimum number of parts, subassemblies, circuits, cards, and modules to maximize standardization and commonality.

Design the equipment for ease of maintenance. Provide component parts that are readily accessible for inspection and maintenance. Provide test points that are for checking essential voltages and waveforms.

3.2. **Electronic Components.** Provide electronic components in accordance with Special Specification 6006, "Electronic Components."

3.3. **Mechanical Components.** Provide external screws, nuts, and locking washers that are stainless steel; no self-tapping screws will be used. Provide parts made of corrosion resistant material, such as plastic, stainless steel, anodized aluminum, or brass. Protect materials from fungus growth and moisture deterioration. Separate dissimilar metals by an inert dielectric material.

3.4. **Documentation Requirements.** Provide documentation in accordance with Special Specification 6005, "Testing, Training, Documentation, Final Acceptance, and Warranty."

3.5. **Testing.** Perform testing in accordance with Special Specification 6005, "Testing, Training, Documentation, Final Acceptance, and Warranty."

3.6. **Experience Requirements.** The Contractor or designated subcontractors involved in the installation and testing of the Ethernet equipment must, as a minimum, meet the following requirements:

- three year experience in the installation of Ethernet equipment;
- two installed systems where Ethernet switches are installed and the systems have been in continuously satisfactory operation for at least 2 yr. The Contractor must submit as proof, photographs or other supporting documents, and the names, addresses, and telephone numbers of the operating personnel who can be contacted regarding the system; and
- provide necessary documentation of subcontractor qualifications pursuant to Contract award.

3.7. **Technical Assistance.** Ensure that a manufacturer's technical representative is available on site to assist the Contractor's technical personnel at each installation site and with Ethernet equipment installation and communication system configuration.

Do not execute the initial powering up of the Ethernet equipment without the permission of the manufacturer's representative.

3.8. **Training.** Provide training in accordance with Special Specification 6005, "Testing, Training, Documentation, Final Acceptance, and Warranty."

3.9. **Warranty.** Provide a warranty in accordance with Special Specification 6005, "Testing, Training, Documentation, Final Acceptance, and Warranty."

4. MEASUREMENT

This Item will be measured as each unit furnished, installed, made fully functional, and tested in accordance with these Special Specifications or as directed.

5. PAYMENT

The work performed and materials furnished, in accordance with this Item and measured as provided under "Measurement," will be paid for at the unit price bid for each "Hardened Ethernet Switch Type 1," or "Hardened Ethernet Switch Type 2." This price will include all equipment described under this Item with all cables and connectors; all documentation and testing; and must also include the cost of furnishing all labor, materials, software, warranty, training, equipment, and incidentals.

Special Specification 6503
Amber Single Line Dynamic Message Sign System

1. DESCRIPTION

Furnish and install amber Single Line Light Emitting Diode (LED) Dynamic Message Sign (SLDMS). Furnish and install SLDMS controller, equipment cabinet, control software, and NTCIP communication protocol for each system. Provide manufacturer approved end user training.

In the case of conflicts between standards and specifications, the latest State of Texas and Department standards and specifications will govern.

2. MATERIALS

2.1. General Requirements. All materials furnished, assembled, fabricated, or installed under this Item must be new, corrosion resistant, and in strict accordance with this Item and the pertinent requirements of the following:

- NEMA TS 4, latest edition,
- NTCIP Requirements,
- TxDOT Special Specification "Intelligent Transportation System (ITS) Ground Mounted Cabinet,"
- TxDOT Special Specification, "Installation of Dynamic Message Sign System," for installation,
- TxDOT Special Specification "Testing, Training, Documentation, Final Acceptance, and Warranty," and
- vendor must be ISO 9001 registered.

Furnish no less than four licensed copies of vendor software on Department laptops for each SLDMS, ensuring at least one electronic copy is delivered, should the licensed copy need to be reinstalled. Any auxiliary software needed for execution or diagnostics will be supplied by the vendor.

Ensure that all materials and construction methods, necessary to complete the installation, are in accordance with the requirements of the Item, the plans, and the pertinent requirements of the following Items.

- Item 432, "Riprap"
- Item 441, "Steel Structures"
- Item 445, "Galvanizing"
- Item 449, "Anchor Bolts"
- Item 618, "Conduit"
- Item 620, "Electrical Conductors"
- Item 656, "Foundations for Traffic Control Devices"

Ensure that the sign displays symbols and text character fonts approved for SLDMS use by the TMUTCD and its accompanying reference documents.

Furnish the following equipment at each SLDMS field site shown on the plans:

- Amber single line DMS, capable of rear mounting onto sign supports specified on TxDOT Standard Details MDM, OSB, COSS, and DMS latest versions;
- sign controller with software, NTCIP compliant;
- SLDMS display mounting brackets and hardware;
- cabling and connectors from power source to SLDMS connection point as specified by the SLDMS manufacturer;

- cabling and connectors from telecommunications source to SLDMS connection point as specified by the SLDMS manufacturer;
- power and communication cabling and connectors from controller to SLDMS must follow NEMA TS4, Section 4, “Controller to Sign Interface”;
- communications as shown on the plans;
- SLDMS cabinet (ground mount) and electronics;
- documentation; and
- all incidentals required for installing a SLDMS.

2.2. **Dynamic Message Sign.** Ensure that the amber SLDMS meets the following requirements.

Provide an Amber SLDMS capable of displaying text consisting of a string of alphanumeric text, punctuation, and other font characters. Provide a display module consisting of a matrix of luminous pixels 7 rows high by 35 columns wide or 7 rows high by 50 columns wide, as shown in the plans. Provide a solid-state display modules. Do not provide mechanical or electromechanical elements or shutters. The configuration details of signs described by this Specification can be seen in Table 1 below.

Table 1

Sign Type	Front Access
Matrix Type	Amber
LED Type **LED Color—Wavelength** **Viewing Angle**	AlInGaP Amber LED Amber—590 ± 5 nm 30°
Pixel Brightness	9,200 cd/m^2
Pixel Pitch	66 mm center-to-center

2.2.1. **Physical Characteristics.**

2.2.1.1. **General Construction.** Equipment design and construction must use the latest available techniques with a minimum number of different parts, subassemblies, circuits, cards, and modules to maximize standardization and commonalty. The equipment should be designed for ease of maintenance. Ensure all component parts must be readily accessible for inspection and maintenance. Provide test points for checking essential voltages.

Securely clamp cables in sign housings with cable attachments. Do not use adhesive attachments.

Ensure performance of the signs will not be impaired due to continuous vibration caused by wind, traffic, or other factors. This includes the visibility and legibility of the display.

Ensure the presence of power transients or electromagnetic fields, including those created by any components of the system, must have no deleterious effect on the performance of the system. Ensure the system does not conduct or radiate signals, which will adversely affect other electrical or electronic equipment including, but not limited to, other control systems, data processing equipment, audio, radio, and industrial equipment.

2.2.1.2. **Front-Access Housing.** Provide a front-access display housing with a maximum total weight of 200 lb. as shown in the SLDMS manufacturer’s Specification or on the plans.

Construct the display housing skin of aluminum alloy 5052-H32 not less than 1/8" thick, unless otherwise specified in this document. Framing structural members must be made of aluminum alloy 6061-T6.

Protect equipment within the sign housing from moisture, dust, dirt, and corrosion. Ensure the front-access housing meets NEMA 3R enclosure criteria as defined in NEMA Standards Publication 250-2008, “Enclosures for Electrical Equipment (1000 V maximum).”

The sign housings are designed in accordance with AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals—6th Edition; for wind speeds of up to 140 mph. AASHTO group load combination includes total sign weight dead load, ice, and wind loads; and the design meets the fatigue requirements for truck-induced gusts.

There must be no exposed fasteners or welds on the housing face.

Provide a minimum of four drain holes in the bottom panel of the housing with snap-in, drain filter plug inserts in each section formed by internal structural members. Ensure water drain filter plug inserts will be replaceable. Ensure weep holes and ventilation or exhaust hoods are screened to prevent the entrance of insects and small animals.

Provide a housing designed to accommodate mounting on the rear vertical plane.

2.2.1.3. **Surface Finish.** The LED panel front face panels and front face border pieces must be finished with semi-gloss black polyvinylidene fluoride (PVDF) applied in accordance with the American Architectural Manufacturers Association (AAMA 2605). Ensure the face is uniform in appearance and completely free from distortion, gouges, and any other flaws or defects.

All other exterior surfaces must be a natural aluminum mill finish. No painted surfaces are allowed.

All interior surfaces must be a natural aluminum mill finish.

2.2.1.4. **Exterior Skin.** Provide an exterior skin for the housing of 5052-H32 aluminum alloy sheet 0.125 in. thick, minimum.

Ensure all exterior seams and joints are sealed from rain and environmental conditions with a weather-tight enclosure, minimizing the number of seams.

Stitch-weld the skin material to the internal structural members to form a unitized structure.

2.2.1.5. **Mounting.** Provide exterior mounting assemblies of 6061-T6 aluminum alloy extrusions, 3/16 in. minimum thickness.

2.2.1.6. **Lens Panel Assembly.** The lens panel assembly must consist of a KYNAR 500-coated aluminum mask over a clear glazing. The aluminum mask must be laminated and sealed to the surface of the glazing using the 3M Scotch VHB joining system or pre-approved equivalent.

2.2.1.7. **Lens Panel Aluminum Mask.** Provide a high-contrast aluminum mask meeting the following:

- black in color containing an opening for each pixel,
- polycarbonate sheet securely attached to the inside of the aluminum panel, and
- perforated to provide an aperture for each pixel on the display modules. Each aperture should be as small as possible without blocking the LED light output at the required viewing angle.

2.2.1.8. **Sign Display.** The face panel clear glazing (if used) should be 90% UV opaque, non-breakable, polycarbonate, or equivalent, minimum 1/8 in. thick, and clear in color. Laminate and seal the glazing to the inside surface of the lens panel.

The sign face must not be subject to fogging, frost, and condensation. If an automatically controlled system is used to keep the front face panel free of fog, frost, and condensation, provide ability for monitoring and control by the sign controller. Heat generated by the system should not damage any part of the SLDMS.

2.2.2. **Environmental Control.** Provide a SLDMS with mixing fans to maintain consistent internal air temperature which allows reliable operations in outdoor ambient temperature of +115°F (+46°C) or less, with full solar load conditions. Provide fans that are removable and replaceable from inside the SLDMS housing

2.2.2.1. **Ventilation.** Provide a ventilation system that moves air across the rear of the LED modules in a manner such that heat dissipates from the LEDs.

2.2.2.2. **Temperature and Humidity.** Provide signs and associated field electronics that satisfy at a minimum Section 2.1.5 "Temperature and Humidity" of the NEMA TS 4, latest revision.

2.3. **Optical and Electrical Requirements.**

2.3.1. **LED and Pixel Characteristics.** Provide AlInGaP LED, Precision Optical Performance T-1 3/4 LED diode that emit amber light and has a peak wavelength of 590 $\pm$ 5 nm. Provide LEDs rated for 100,000 hr. continuous operations while maintaining a minimum of 50% of the original brightness. Ensure the LED module has a printed circuit board to which LED pixels and electronic drive circuitry are soldered. Provide a LED pixel matrix with each pixel containing the quantity of discrete amber LEDs needed to output a minimum luminous intensity of 9,200 candelas per m² when measured using a photometric meter through the SLDMS front face panel assembly. Through-hole LEDs mounted flush to the printed circuit board are not acceptable. Surface-mount LEDs are not acceptable. The LED brightness that is used in each pixel will be provided to the engineer for approval. Provide certification with the submittal from the LED manufacturer that demonstrates that the LEDs were tested.

The pixel strings will be powered from a regular DC power source and the LED must be maintained at a current level to maximize life of the pixel. The failure of an LED in one string within a pixel should not affect the operation of any other string or pixel.

The LEDs must be individually mounted directly to a printed circuit board and should be easily replaceable and individually removable using conventional, electronic repair methods.

2.3.2. **Display Module and Driver Boards.** Provide SLDMS with LED display module consisting of one circuit board per LED display module with a matrix of LED pixels. The pixels are mounted on the front side of the display module.

The driver board connects to the sign interface circuits and passes information to the associated display modules, which control the character pixels. The driver board must receive control signals and display data from the sign controller. The display module must contain the control and memory elements and provide the signals to switch and read the LED pixels.

The driver boards must connect to a single control cable common to each line of display modules.

The LED display board must contain all LEDs required to form a matrix of pixels. Pixels should be arranged uniformly to display a dot-matrix character of the desired height and width. The height of a standard character will be defined as the distance from the lowest point of the lowermost pixel of the character to the highest point of the uppermost pixel of the character. Smaller characters are not acceptable.

The display modules must be rectangular and have an identical horizontal and vertical pitch between pixels.

The separation between the last column of one module and the first column of the next must be equal to the horizontal distance between the columns of a single display module.

The separation between the last row of one module and the first row of the next must be equal to the horizontal distance between the rows of a single display module.

All LEDs must be individually and directly mounted to the LED circuit board to form the LED display board. The LED display board should support the driver board.

All LEDs must be mounted so that their mechanical axis is normal +/- 1.00° to the face of the sign to ensure brightness uniformity over the face of the sign.

Design modules, such that failure of one or more pixels, does not affect the operation of other pixels. Ensure failure of any module does not affect the operation of other modules.

Conformal coat Printed Circuit Boards (PCB) with a minimum 0.005 in. (5 mil) thick silicone resin or acrylic resin conformal coat. Use coating material that complies with military specification MIL-I-46058C Type SR and IPC-CC-830.

2.3.3. **Display Assembly.** Provide an LED display module with a LED display circuit board. Ensure a single data exchange and addressing cable connects the driver board to the LED boards it controls that are not directly attached to the driver board. The driver board must contain the solid-state electronics necessary to control pixel data and read pixel status.

Provide LED boards and driver boards are fully interchangeable and must not require any manual addressing switches or adjustment when interchanged or placed in service.

Provide display modules that can be mounted to the display face in a manner that facilitates easy and rapid removal of each display module without disturbing adjacent display modules. Ensure replacement of a complete display module must be possible without the use of any tools.

2.3.4. **Legibility.** Provide SLDMS display legible under all light conditions at a distance of 150 ft. to 1,100 ft. from the LED panel face, when displaying 18" characters, within the degree cone of vision centered around the optical axis of the pixel.

Ensure proper brightness in all lighting conditions for optimum legibility. The SLDMS must be bright enough to have a good target value, but not to the point where the pixels bloom, especially in low ambient light level conditions.

Provide uniform brightness and color of each pixel over the entire face of the sign within the cone of vision from 300 ft. to 50 ft. in all lighting conditions. Non-uniformity of brightness or color over the face of the sign under these conditions will be cause for rejection of the sign.

Meet the minimum Section 8.8 "Brightness Controls" of the NEMA TS 4, latest revision. Provide a controller with the capability of monitoring and self-adjusting the brightness of the display. Ensure brightness is manually and automatically adjustable from the local sign controller. Enable brightness control to be set to specific levels from the sign controller (local), laptop (remote), and Lonestar™ (central) software.

2.3.5. **Characters Displayed.** Provide SLDMS displays capable of displaying ASCII characters 32 through 126 (including all upper- and lowercase letters and digits from 0 to 9).

Provide a SLDMS display that is capable of displaying one row of 18 in. tall characters, displaying 7 or 10 characters on each row as shown on plans. Pixel pitch must be 66 mm. Each font may be edited and downloaded to the sign controller from the central controller or laptop computer at any time without any software or hardware modification.

2.3.6. **LED DC Power.** Ensure the voltage to the SLDMS displays and associated electronics does not exceed 24 VDC. The power supplies must have an efficiency of 80%.

The power supplies must be wired in a redundant configuration that uses multiple supplies for the SLDMS display matrix. Power supplies must be redundant and rated such that if one supply fails, the remaining supply must be able to supply 100% of the pixels in that display region at 100% brightness.

The power supplies used to power the LED pixel modules must be identical and interchangeable throughout the SLDMS.

Power supplies will be UL listed, meet the NEC, and have an application of coating to protect from the environmental elements.

2.3.7. **Photoelectric Sensor Devices.** Three photocells must be installed in the sign. These devices should permit automatic light intensity measurement of light conditions at each sign location. These photocells must be mounted in a manner to measure front, rear, and ambient light conditions.

Automatic adjustment of the LED brightness must occur in small enough increments so that the brightness of the sign changes smoothly, with no perceivable brightness change between adjacent levels. Provision must be made to prevent perceivable brightening of the sign due to stray headlights shining upon the photo sensors at night.

There must be a means to adjust how rapidly the sign responds to changes in ambient light as measured by the photocells. This can be used, for example, to prevent the sign from changing its brightness due to a vehicle's headlight momentarily shining on the sign. The adjustment must be made from the central controller or laptop computer and should have two different settings, one for daytime control and one for nighttime control, with the day or night ambient light threshold also being an adjustable value. In addition, there should be a means to specify different weighting factors for each photocell to specify how prominently each photocell figures in the calculation of nighttime ambient light.

2.3.8. **Power.** The sign and its sign controller must be capable of operating with 120/240 VAC, 10 A per leg maximum, 60 Hz, single-phase power.

Inside the sign housing, all 120 VAC service lines must be independently protected by a thermomagnetic circuit breaker at the sign housing entry point. All 120 VAC wiring must be located in conduit, pull boxes, raceways, or control cabinets as required by the latest version of the National Electric Code (NEC). No 120 VAC wiring must be exposed to the inside or outside of the sign housing. The sign housing must not be considered as a raceway or control cabinet.

The presence of power transients or electromagnetic fields, including those created by any components of the system, must have no deleterious effect on the performance of the system. The system must not conduct or radiate signals which will adversely affect other electrical or electronic equipment including, but not limited to, other control systems, data processing equipment, audio, radio, and industrial equipment.

The system power lines must be protected by transient voltage suppression devices including MOVs and spark gap arrestor.

The efficiency of the power supply must be 80% or greater and the power supply must have a power factor of 0.95 or greater.

A minimum of two power supplies must be provided for redundancy. Power supplies must be designed such that if one supply fails, the remaining supply must be able to operate 100% of the pixels at full brightness. Supply 50%, 80%, and 100% full-load calculations for Volt-Amps-Reactive (VARs) and Volt-Amps (VA) loads consumed by SLDMS sign, operating at 120 VAC.

The sign controller must monitor and report to Lonestar™ the output voltage and functional status of regulated Direct-Current (DC) power supplies located in the SLDMS by monitoring diagnostic outputs located on these power supplies.

Ensure GFCI devices protect all service outlets. At a minimum, a there must be a utility outlet circuit with two 15-A NEMA 15-R, 120 VAC duplex outlet inside the cabinet, with a minimum of one outlet having GFCI.

Ensure AC cables are type Cross-Linked High Heat Water (XHHW) and sized as required by the NEC.

The sign housing must have one earth ground lug that is electrically bonded and located near the power entrance location on the sign housing.

All earth grounding will conform to the National Electric Code.

2.3.9. **Transients.** The equipment must meet the performance requirements specified in Section 2.1.4 of the NEMA standard TS4.

2.4. **Field Equipment Cabinet.** For each SLDMS, furnish one ground-mount cabinet configuration as specified on the plans. Furnish cabinet meeting minimum materials and construction requirements of Special Specifications Item, "Intelligent Transportation Systems (ITS) Ground Mounted Cabinet" (applicable to cabinet only) with additional features described herein.

Provide the following items in the field equipment cabinet:

- power-on indicator,
- room for communication devices (shelf mounted and rack-mounted switches, Ethernet switches, fiber distribution equipment),
- alarm switch when the cabinet has been opened and capable of communicating with Lonestar™,
- a full-height standard EIA 19-inch rack (The rack must be secured within the cabinet by mounts at the top and bottom.),
- a minimum of one empty pull-out drawer. (Ensure drawer is capable of supporting a 20 lb. load.), and
- outdoor rated markings and identification on the power protection panel.

2.5. **Sign Controller.** Provide a SLDMS controller with resident software. Ensure controller has a what-you-see-is-what-you-get (WYSIWYG) LCD display, representing the message being displayed. Perform all communication, control, and feedback functions and diagnostics testing for the SLDMS through the local sign controller. Ensure sign controller supports all Lonestar™ software functionality.

Include a front panel user interface with graphical LCD or keypad for direct operation and diagnostics as described herein (keypad not needed for touchscreen interface).

Send and receive messages from the SLDMS controller through the communication demarcation point in cabinet via the communications port housed in the field equipment cabinet. Furnishing and installation of communications and power cables from the cabinet to the utility service or the communications demark are described in other Specifications.

The controller must have power-up and auto-restart capabilities with a programmable default message (including a blank message) when recovering from a power off condition. A hardware watch dog circuit must be used to provide automatic reset to the controller and the modem. The central computer must be capable of remotely commanding a controller and modem reset.

The sign controller must be capable of being controlled from the central controller or the laptop computer.

2.5.1. **Modes of Operation.** Ensure the modes of operation are consistent with those defined in NTCIP, specifically Local, Central, and Central Override.

Ensure the SLDMS controller can monitor individual sensors statuses. Provide a controller with the ability to pass sensor information to Lonestar™ such as Power Status Data, Temperature Sensor Data, and Light Sensor Data as defined in NTCIP 1203. Provide a controller that will integrate with a cabinet door-open sensor and report back door-open status to Lonestar™.

In the event of a communications failure with the SLDMS central control software, the local sign controller sets the sign to blank, all pixels off, after a user-defined number of minutes unless communications are restored within this period. Provide communications loss message as defined by NTCIP by Lonestar™.

Provide a controller that can be remotely resettable from the central control software.

2.6. **Communication.**

2.6.1. **Ports for Remote Communication.** Provide a minimum of one 10/100Base-T Ethernet communication port with RJ45 connector.

2.6.2. **Ports for Local Communication.** Provide a minimum of one 10/100Base-T Ethernet communication port with RJ45 connector.

2.6.3. **Protocols.** Support communications protocols in accordance with all commands defined in Section 8-.10-7 "NTCIP Protocol and Command Sets" of the NEMA TS 4, latest version. Ensure the communications ports for the sign act in accordance with all TxDOT NTCIP user defined commands.

2.6.4 **Communication Interface.** Provide separate serial interfaces for communication with the central controller and the laptop computer.

Comply with the National Transportation Communications for ITS Protocol (NTCIP) between the SLDMS controller and the central controller or laptop computer. Unless otherwise stated, the software will comply with the versions of the relevant NTCIP standards that are current at the date of this document.

In addition to the standard MIB objects, the sign should include any additional manufacturer-specific MIB objects required to support all of the sign and central software functionality defined elsewhere in this Specification.

2.7. **Clock and Timer.**

2.7.1. **Internal Clock.** Provide a computer-readable clock that has a battery backup circuit that will keep the clock operating properly for at least five years without external power, and the clock must automatically adjust for daylight savings time and leap year using hardware, software, or a combination of both.

2.7.2. **Watchdog.** Meet at a minimum Section 8.9.5 "Watchdog Time" of the NEMA TS 4, latest version.

During watchdog timer reset, the sign must be blank, with all pixels off.

When polled by Lonestar™, submit a status report to the central control software when a watchdog event has occurred, including the current sign status and wait in a neutral state until further instructions are sent from the statewide central control software, or until manually reset by local control.

2.8. **Initial Documentation.** Before sign manufacturing, provide SLDMS manufacturer's documentation for each system comprised of the SLDMS displays, controller, and equipment cabinet in a searchable PDF manual and submit for approval. Provide electronic copies of the manual and a minimum of one paper copy of the manual for each sign delivered. Ensure that SLDMS manufacturer's manual includes the following:

- independent laboratory test reports explaining testing process and verification worksheet displaying NEMA TS 4 compliance;
- verification of NTCIP compliance. The Department will verify, through use of the Department's NTCIP Tester, that the equipment complies with the requirements of NTCIP 1101 Simple Transportation Management Framework; NTCIP 2101, Subnet Profile for PMPP;
- vendor must submit documentation of successful software compliance testing with TxDOT's Lonestar™ SLDMS subsystem, latest version. Maintenance software must be provided by the vendor to the Department at no cost to the Department. This software must allow fonts to be added or changed by the Department;
- documented testing procedures (see Section 3.5);
- SLDMS shop drawings;
- power load requirements;
- complete and accurate schematic diagrams including circuit board schematics;

- complete and accurate cabinet, enclosure, and building wiring diagrams;
- complete installation procedures;
- complete performance Specifications (functional, electrical, mechanical, and environmental) on the unit;
- complete parts list including names of vendors for parts not identified by universal part numbers such as JEDEC, RETMA, or EIA;
- pictorial of component layout on circuit board;
- complete stage-by-stage explanation of circuit theory and operation;
- complete and detailed system operations manuals;
- data necessary for isolation and repair of failures or malfunctions, assuming the maintenance technicians to be capable of analytical reasoning using the information provided in above subsection. Describe accuracy, limits, and tolerances for all electrical, physical, or other applicable measurements. Include general instructions for disassembly, overhaul, and reassemble, including shop specifications or performance requirements;
- detailed instructions where failure to follow special procedures would result in damage to the equipment, improper operation, or danger to operating or maintenance personnel. Such instructions and Specifications should be included only for such maintenance as may be accomplished by specialized technicians and engineers in a modern Electro mechanical shop. Describe special test setup, component fabrication, and the use of special tools, jigs, and test equipment;
- A detailed physical description of size, weight, special mounting requirements, electrical connections, power requirements, and all other pertinent information necessary for proper installation and use of the equipment. Ensure the vendor works with Contractor to submit sign supports and support brackets;
- periodic maintenance schedule; and
- a list of certified maintenance personnel, including qualifications, experience, and applicable certifications of individuals who may be performing maintenance on products as required by this Specification.

3. CONSTRUCTION

3.1. **General.** Install Contractor-furnished SLDMS according to the manufacturer's recommendations and in accordance to Section 3 of SS6028 "Dynamic Message Sign System." Ensure installation and configuration of software on Department computers are included with the Amber SLDMS.

3.2. **Requirements for Shop Drawings.** Submit shop drawings in Microstation DGN and PDF format for approval before fabrication; include the sign structural members and attachment supports in accordance with Standard Specification Item 5 Article 5.2 "Plans and Working Drawings." Shop drawings must be sealed by a licensed professional engineer (Licensed in the U.S.).

3.3. **Delivery.** Deliver SLDMS sign and cabinet to the location determined by the Department, including removing from delivery truck onto ground. The Department will not provide any crane equipment to lift equipment off of truck. Must provide equipment to lift. The Department will not be held liable for any damages incurred during shipment, including lifting the sign from delivery truck onto ground. Delivery will not be complete until SLDMS sign, and cabinet has been unloaded onto ground, secured to prevent tipping, and passed the demonstration test.

3.3.1. **Final Documentation**. Provide as-built final documentation for approval reflecting all field changes and software modifications. Include detailed drawings of conduit layouts, cable diagrams, wiring lists, cabinet layouts, wiring diagrams, and schematics for all elements of the communications system. Include the cable type, color code, function, the routing of all conductors' pairs in the cable diagrams, and wiring lists.

Provide manufacturer's software, documentation, and intellectual property rights for the computer software system and components. These must include, but are not limited to, the following:

- deliver: one copy of all documentation supplied by the manufacturers for all plug-in circuit cards used in the microcomputer chassis.
- license: grant the department a non-exclusive unrestricted license that will allow the Department to use, modify, or distribute any or all of the stated communication protocols and documentation.
- technical assistance: include instructions for troubleshooting and warranty replacements.

3.4. **Testing.** Ensure that the Department receives a sign capable of complying with the following test procedures which will be performed upon delivery of the SLDMS to the Contractor's yard and again at installation of the SLDMS on the support structure as located on the plans.

3.4.1. **Examination of Product.** Contractor will examine each unit carefully to verify that the materials, design, construction, markings, and workmanship are in accordance with the requirements of the parent Specification. Department may also verify that the SLDMS furnished by the Contractor meets Specification.

3.4.2. **Continuity Tests.** Department may check the wiring to determine conformance with the requirements.

3.4.3. **Operational Test.** Contractor will operate each unit for 2 hr. to permit equipment temperature stabilization and an adequate number of performance characteristics to ensure compliance with the requirements.

3.4.4. **Pixel Status Tests.** Contractor will conduct pixel status tests to ensure the pixels are fully functional. Ensure that Vendor must provide detection for out-of-service LED pixels through testing procedures conducted through the sign controller. When polled, controller must be required to report results to Lonestar™ SLDMS central software.

- Pixel test: Sign must be capable of a full operational status of each pixel and report of the status to the local sign controller. Upon request from Lonestar™ software, sign should identify a list of modules with defective pixels. The pixel test may briefly disturb the displayed message for no more than 0.5 sec.
- Pixel read: Sign must be capable of reporting back to the local controller which pixels are on or off. Upon request from Lonestar™ software, sign should provide a list of which pixels are on or off. Pixel read should not interfere the displayed message.

3.4.5. **SLDMS Testing Procedures.** Contractor to coordinate with the vendor to be present during all testing. Submit manufacturer-approved test procedures and worksheets detailing the following tests to ensure SLDMS meets all Specifications defined:

- initial demonstration, and
- stand-alone.

Contractor will ensure that vendor representative will perform both tests at location determined by the Department.

3.5. **Warranty.** Ensure that the installed amber SLDMS has a manufacturer's warranty. Materials and parts must be warranted for a minimum of 5 yr. from accepted installation date. The accepted installation date is defined as the date that the Department determines that the sign has passed all testing requirements. The warranty must cover all defects in material, parts, design, and workmanship, including remote diagnostics. The vendor must submit the terms of warranty in writing.

4. MEASUREMENT

This Item will be measured as each Amber Single Line DMS furnished, installed, made fully operational, and tested in accordance with this Special Specification.

5. PAYMENT

The work performed and materials furnished, in accordance with this Item and measured as provided under "Measurement," will be paid for at the unit price bid for "Amber SLDMS" of the SLDMS size and cabinet type

(if required) specified. This price is full compensation for furnishing, transportation, and installation of SLDMS and its equipment cabinet; furnishing and installing any new mounting hardware and SLDMS controller cabinet; storing the SLDMS when required; cleaning and testing the SLDMS; replacement or repair of damaged components; disposal of unsalvageable material, and for all manipulations, labor, tools, working drawings, equipment, and incidentals. This price is full compensation for furnishing, placing, and testing all materials and equipment, and for all tools, labor, equipment, hardware, operational software packages, communication cable and media converters (if required), supplies, support, personnel training, shop drawings, documentation, and incidentals.

New overhead sign supports or relocation of existing overhead sign supports will be paid for under Item 650, “Overhead Sign Supports.” New drilled shaft foundations will be paid for under Item 416, “Drilled Shaft Foundations.” New electrical conductors for power distribution will be paid for under Item 620, “Electrical Conductors.”

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