

# NOTIFICATION OF ADDENDUM

## ADDENDUM NO. 1

**DATED 10/28/2016**

<b>Control</b>	<b>0902-48-722</b>
<b>Project</b>	<b>STP 2012(777)MM</b>
<b>Highway</b>	<b>CS</b>
<b>County</b>	<b>TARRANT</b>

Ladies/Gentlemen:

Attached please find an addendum on the above captioned project. Included in the attachment is an addendum notification which details the changes and the respective proposal pages which were added and/or changed.

Except for new bid insert pages, it is unnecessary to return any of the pages attached.

Bid insert pages must be returned with the bid proposal submitted to the Department, unless your firm is submitting a bid using a computer print out. The computer print out must be changed to reflect the new bid item information.

Contractors and material suppliers, etc. who have previously been furnished informational proposals are not being furnished a copy of the addendum. If you have a subcontractor on the above project, please advise them of this addendum. Acknowledgment of this addendum is not requested if your company has been issued a proposal stamped "This Proposal Issued for Informational Purposes."

You are required to acknowledge receipt of this addendum on the Addendum Acknowledgement form contained in your bid proposal by placing a mark in the box next to the respective addendum.

Failure to Acknowledge receipt of this addendum in your bid proposal will result in your bid not being read.

SUBJECT: PLANS AND PROPOSAL ADDENDUMS  
PROJECT: STP 2012(777)MM CONTROL: 0902-48-722  
COUNTY: TARRANT  
LETTING: 11/03/2016  
REFERENCE NO: 1028

**PROPOSAL ADDENDUMS**

- \_ PROPOSAL COVER  
X BID INSERTS (SH. NO.: 2-17 - 17-17 )  
X GENERAL NOTES (SH. NO.: DD )  
  
X SPEC LIST (SH. NO.: 3-4,4-4 )  
\_ SPECIAL PROVISIONS:  
\_ ADDED:  
  
DELETED:  
  
X SPECIAL SPECIFICATIONS:  
ADDED: 6010, 6016, 6029, 6062, 6064, 6186  
  
DELETED:  
  
X OTHER: SEE CHANGES OUTLINED BELOW

DESCRIPTION OF ABOVE CHANGES  
(INCLUDING PLANS SHEET CHANGES)

BID INSERTS: SHEET 2-17 - REVISED QUANTITY FOR ITEM 260-6043  
ADDED ITEM 260-6022.  
SHEET 3-17 - ADDED ITEM 416-6006.  
SHEET 4-17 - REVISED QUANTITY FOR ITEM 422-6016.  
ADDED ITEM 432-6005.  
SHEET 10-17 - REVISED QUANTITY FOR ITEM 618-6029.  
ADDED ITEMS 618-6047,618-6054,618-6074 AND 620-6007.  
SHEET 11-17 - ADDED items 620-6015,620-6016 AND 628-6149.  
SHEET 17-17 - ADDED ITEMS 6010-6001,6010-6003,6010-6004,  
6016-6006,6016-6011,6029-6001,6062-6018,6064-6055,6064-6092,  
6186-6002 and 6186-6008.  
DUE TO THE CHANGES ABOVE ITEMS ON SHEET 2-17 - 17-17 MAY HAVE  
SHIFTED AND SHEET 18-19 AND 19-19 ARE ADDED.  
GENERAL NOTES: SHEET DD - ADDED ITS NOTES.  
SHEET DD - OO - INFORMATION MAY HAVE SHIFTED DUE TO THE  
CHANGES ABOVE.  
SPEC LIST: SHEET 3-4 - ADDED SS ITEMS 6010,6016,6029,6062,6064 AND 6186.  
SHEET 3-3 - 4-4 - INFORMATION MAY HAVE SHIFTED DUE TO THE  
CHANGES ABOVE

DESCRIPTION OF ABOVE CHANGES (CONTINUED)  
(INCLUDING PLANS SHEET CHANGES)

PLAN SHEETS: REPLACED SHEETS 2,3,7 THRU 13,14,14A THRU 14N,15,15A THRU 15D  
,19 AND 90.  
ADDED SHEETS 3A,14O,14P,14Q,14R,14S,14T,320 AND 321 THRU 344.

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	31.200	1
	100	6009		PREPARING ROW (TREE) (6" TO 24" DIA)  DOLLARS and CENTS	EA	12.000	2
	100	6011		PREPARING ROW(TREE)(24" TO 36" DIA.)  DOLLARS and CENTS	EA	1.000	3
	104	6001		REMOVING CONC (PAV)  DOLLARS and CENTS	SY	6,444.400	4
	104	6009		REMOVING CONC (RIPRAP)  DOLLARS and CENTS	SY	693.200	5
	104	6015		REMOVING CONC (SIDEWALKS)  DOLLARS and CENTS	SY	37.900	6
	104	6017		REMOVING CONC (DRIVEWAYS)  DOLLARS and CENTS	SY	322.600	7
	104	6021		REMOVING CONC (CURB)  DOLLARS and CENTS	LF	3,561.300	8
	110	6001		EXCAVATION (ROADWAY)  DOLLARS and CENTS	CY	6,599.700	9
	132	6008		EMBANKMENT (FINAL)(DENS CONT)(TY D)  DOLLARS and CENTS	CY	13,403.200	10
	161	6017		COMPOST MANUF TOPSOIL (4")  DOLLARS and CENTS	SY	16,559.800	11
	162	6002		BLOCK SODDING  DOLLARS and CENTS	SY	4,364.300	12

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	164	6035		DRILL SEEDING (PERM) (RURAL) (CLAY) DOLLARS and CENTS	SY	12,195.500	13
	168	6001		VEGETATIVE WATERING DOLLARS and CENTS	MG	579.600	14
	247	6060		FL BS (CMP IN PLC)(TY E GR 4)(FNAL POS) DOLLARS and CENTS	CY	1,442.100	15
	260	6022		LIME TRT (EXIST MATL)(18") DOLLARS and CENTS	SY	2,000.000	16
	260	6027		LIME TRT (EXST MATL)(8") DOLLARS and CENTS	SY	19,492.110	17
	260	6043		LIME (HYD, COM OR QK)(SLURRY) DOLLARS and CENTS	TON	424.900	18
	275	6001		CEMENT DOLLARS and CENTS	TON	58.900	19
	305	6052		SALV, HAUL & STKPL RCL APH PV (0-12") DOLLARS and CENTS	SY	5,823.400	20
	310	6001		PRIME COAT (MULTI OPTION) DOLLARS and CENTS	GAL	3,898.440	21
	341	6008		D-GR HMA TY-B PG64-22 DOLLARS and CENTS	TON	5,724.180	22
	341	6272		D-GR HMA TY C SAC-B PG70-28(LATEX ADD) DOLLARS and CENTS	TON	195.270	23
	360	6003		CONC PVMT (CONT REINF - CRCP) (9") DOLLARS and CENTS	SY	15,845.950	24

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	400	6006		CUT & RESTORING PAV  DOLLARS and CENTS	SY	560.800	25
	402	6001		TRENCH EXCAVATION PROTECTION  DOLLARS and CENTS	LF	2,119.000	26
	403	6001		TEMPORARY SPL SHORING  DOLLARS and CENTS	SF	19,431.000	27
	416	6001		DRILL SHAFT (18 IN)  DOLLARS and CENTS	LF	299.000	28
	416	6004		DRILL SHAFT (36 IN)  DOLLARS and CENTS	LF	1,024.000	29
	416	6006		DRILL SHAFT (48 IN)  DOLLARS and CENTS	LF	21.000	30
	416	6018		DRILL SHAFT (SIGN MTS) (24 IN)  DOLLARS and CENTS	LF	12.000	31
	416	6019		DRILL SHAFT (SIGN MTS) (30 IN)  DOLLARS and CENTS	LF	40.000	32
	416	6032		DRILL SHAFT (TRF SIG POLE) (36 IN)  DOLLARS and CENTS	LF	54.000	33
	416	6034		DRILL SHAFT (TRF SIG POLE) (48 IN)  DOLLARS and CENTS	LF	22.000	34
	420	6014		CL C CONC (ABUT)(HPC)  DOLLARS and CENTS	CY	181.400	35
	420	6026		CL C CONC (BENT)(HPC)  DOLLARS and CENTS	CY	104.500	36

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	420	6060		CL C CONC (INLET)  DOLLARS and CENTS	CY	5.150	37
	422	6002		REINF CONC SLAB (HPC)  DOLLARS and CENTS	SF	24,865.800	38
	422	6013		BRIDGE SIDEWALK  DOLLARS and CENTS	SF	3,733.400	39
	422	6016		APPROACH SLAB (HPC)  DOLLARS and CENTS	CY	310.400	40
	423	6001		RETAINING WALL (MSE)  DOLLARS and CENTS	SF	30,946.000	41
	423	6008		RETAINING WALL (CAST - IN - PLACE)  DOLLARS and CENTS	SF	1,750.000	42
	425	6037		PRESTR CONC GIRDER (TX40)  DOLLARS and CENTS	LF	3,921.250	43
	432	6002		RIPRAP (CONC)(5 IN)  DOLLARS and CENTS	CY	3.700	44
	432	6005		RIPRAP (CONC) (CL A )  DOLLARS and CENTS	CY	1.250	45
	432	6008		RIPRAP (CONC)(CL B)(RR8&RR9)  DOLLARS and CENTS	CY	5.700	46
	432	6010		RIPRAP (CONC)(CL B)(5 IN)  DOLLARS and CENTS	CY	12.900	47
	432	6044		RIPRAP (CONC)(FLUME)  DOLLARS and CENTS	CY	60.000	48

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	ITEM NO	DESC CODE	S.P. NO.				
	432	6045		RIPRAP (MOW STRIP)(4 IN)  DOLLARS and CENTS	CY	49.620	49
	432	6046		RIPRAP (MOW STRIP)(5 IN)  DOLLARS and CENTS	CY	50.000	50
	442	6007		STR STEEL (MISC NON - BRIDGE)  DOLLARS and CENTS	LB	375.000	51
	450	6023		RAIL (TY SSTR)  DOLLARS and CENTS	LF	1,081.000	52
	450	6037		RAIL (TY C411)(HPC)  DOLLARS and CENTS	LF	918.300	53
	450	6042		RAIL (TY PR1)  DOLLARS and CENTS	LF	175.000	54
	454	6001		SEALED EXPANSION JOINT (4 IN) (SEJ - A)  DOLLARS and CENTS	LF	298.200	55
	462	6010		CONC BOX CULV (6 FT X 3 FT)  DOLLARS and CENTS	LF	59.000	56
	462	6019		CONC BOX CULV (8 FT X 4 FT)  DOLLARS and CENTS	LF	319.000	57
	464	6005		RC PIPE (CL III)(24 IN)  DOLLARS and CENTS	LF	1,627.000	58
	464	6008		RC PIPE (CL III)(36 IN)  DOLLARS and CENTS	LF	114.000	59
	465	6186		MANH(COMPL)(TY 1 )  DOLLARS and CENTS	EA	5.000	60

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	ITEM NO	DESC CODE	S.P. NO.				
	465	6187		INLET(COMPL)(DROP)(TY 1)(1 GRATE) DOLLARS and CENTS	EA	2.000	61
	465	6193		INLET(COMPL)CL(2)-02 (FW)(10') DOLLARS and CENTS	EA	7.000	62
	465	6194		INLET(COMPL) CL(2)-02 (FW)(15') DOLLARS and CENTS	EA	2.000	63
	465	6195		INLET(COMPL)CL(2)-02 (FW)(20') DOLLARS and CENTS	EA	4.000	64
	465	6275		MANH (COMPL)(JUNCT BOX) DOLLARS and CENTS	EA	1.000	65
	466	6195		WINGWALL (PW - 2) (HW=6 FT) DOLLARS and CENTS	EA	1.000	66
	467	6208		SET (TY I)(S= 6 FT)(HW= 3 FT)(6:1) (P) DOLLARS and CENTS	EA	1.000	67
	467	6389		SET (TY II) (24 IN) (RCP) (3: 1) (P) DOLLARS and CENTS	EA	1.000	68
	479	6001		ADJUSTING MANHOLES DOLLARS and CENTS	EA	2.000	69
	479	6004		ADJUSTING MANHOLES (SANITARY) DOLLARS and CENTS	EA	4.000	70
	479	6005		ADJUSTING MANHOLES (WATER VALVE BOX) DOLLARS and CENTS	EA	1.000	71
	479	6008		ADJUSTING MANHOLES (WATER METER) DOLLARS and CENTS	EA	2.000	72

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	496	6002		REMOV STR (INLET)  DOLLARS and CENTS	EA	4.000	73
	496	6003		REMOV STR (MANHOLE)  DOLLARS and CENTS	EA	2.000	74
	496	6004		REMOV STR (SET)  DOLLARS and CENTS	EA	3.000	75
	496	6006		REMOV STR (HEADWALL)  DOLLARS and CENTS	EA	4.000	76
	496	6007		REMOV STR (PIPE)  DOLLARS and CENTS	LF	458.600	77
	496	6010		REMOV STR (BRIDGE 100 - 499 FT LENGTH)  DOLLARS and CENTS	EA	1.000	78
	496	6043		REMOV STR (SMALL FENCE)  DOLLARS and CENTS	LF	507.800	79
	500	6001		MOBILIZATION  DOLLARS and CENTS	LS	1.000	80
	502	6001		BARRICADES, SIGNS AND TRAFFIC HAN- DLING  DOLLARS and CENTS	MO	17.000	81
	506	6002	002	ROCK FILTER DAMS (INSTALL) (TY 2)  DOLLARS and CENTS	LF	58.000	82
	506	6011	002	ROCK FILTER DAMS (REMOVE)  DOLLARS and CENTS	LF	58.000	83
	506	6020	002	CONSTRUCTION EXITS (INSTALL) (TY 1)  DOLLARS and CENTS	SY	78.000	84

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	ITEM NO	DESC CODE	S.P. NO.				
	506	6024	002	CONSTRUCTION EXITS (REMOVE) DOLLARS and CENTS	SY	78.000	85
	506	6038	002	TEMP SEDMT CONT FENCE (INSTALL) DOLLARS and CENTS	LF	2,847.000	86
	506	6039	002	TEMP SEDMT CONT FENCE (REMOVE) DOLLARS and CENTS	LF	2,847.000	87
	506	6042	002	BIODEG EROSN CONT LOGS (INSTL) (18") DOLLARS and CENTS	LF	220.000	88
	506	6043	002	BIODEG EROSN CONT LOGS (REMOVE) DOLLARS and CENTS	LF	220.000	89
	508	6001		CONSTRUCTING DETOURS DOLLARS and CENTS	SY	1,728.600	90
	512	6013		PORT CTB (DES SOURCE)(SGL SLP)(TY 1) DOLLARS and CENTS	LF	4,110.000	91
	512	6025		PORT CTB (MOVE)(SGL SLP)(TY 1) DOLLARS and CENTS	LF	720.000	92
	512	6037		PORT CTB (STKPL)(SGL SLP)(TY 1) DOLLARS and CENTS	LF	4,110.000	93
	529	6005		CONC CURB (MONO) (TY II) DOLLARS and CENTS	LF	3,667.600	94
	529	6008		CONC CURB & GUTTER (TY II) DOLLARS and CENTS	LF	841.290	95
	530	6004		DRIVEWAYS (CONC) DOLLARS and CENTS	SY	293.300	96

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	ITEM NO	DESC CODE	S.P. NO.				
	531	6001		CONC SIDEWALKS (4") DOLLARS and CENTS	SY	1,582.520	97
	531	6009		CURB RAMPS (TY 6) DOLLARS and CENTS	EA	4.000	98
	531	6010		CURB RAMPS (TY 7) DOLLARS and CENTS	EA	7.000	99
	531	6016		CURB RAMPS (TY 21) DOLLARS and CENTS	EA	4.000	100
	531	6032		CONC SIDEWALKS (SPECIAL) (TYPE A) DOLLARS and CENTS	SY	31.900	101
	536	6004		CONC DIRECTIONAL ISLAND DOLLARS and CENTS	SY	1,077.940	102
	540	6001		MTL W-BEAM GD FEN (TIM POST) DOLLARS and CENTS	LF	1,268.500	103
	540	6007		MTL BEAM GD FEN TRANS (TL2) DOLLARS and CENTS	EA	3.000	104
	540	6016		DOWNSTREAM ANCHOR TERMINAL SEC- TION DOLLARS and CENTS	EA	2.000	105
	542	6001		REMOVE METAL BEAM GUARD FENCE DOLLARS and CENTS	LF	1,347.700	106
	542	6002		REMOVE TERMINAL ANCHOR SECTION DOLLARS and CENTS	EA	4.000	107
	543	6002		CABLE BARRIER SYSTEM (TL-4) DOLLARS and CENTS	LF	1,306.000	108

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	543	6020		CABLE BARRIER TERMINAL SECTION (TL-4)  DOLLARS and CENTS	EA	2.000	109
	543	6021		REMOVE CABLE BARRIER  DOLLARS and CENTS	LF	1,306.000	110
	543	6022		REMOVE CABLE BARRIER TERMINAL SECTION  DOLLARS and CENTS	EA	2.000	111
	544	6001		GUARDRAIL END TREATMENT (INSTALL)  DOLLARS and CENTS	EA	4.000	112
	544	6003		GUARDRAIL END TREATMENT (REMOVE)  DOLLARS and CENTS	EA	2.000	113
	545	6001		CRASH CUSH ATTEN (INSTL)  DOLLARS and CENTS	EA	8.000	114
	545	6003		CRASH CUSH ATTEN (MOVE & RESET)  DOLLARS and CENTS	EA	3.000	115
	545	6005		CRASH CUSH ATTEN (REMOVE)  DOLLARS and CENTS	EA	8.000	116
	556	6008		PIPE UNDERDRAINS (TY 8) (6")  DOLLARS and CENTS	LF	1,774.000	117
	618	6023		CONDT (PVC) (SCH 40) (2")  DOLLARS and CENTS	LF	155.000	118
	618	6029		CONDT (PVC) (SCH 40) (3")  DOLLARS and CENTS	LF	1,040.000	119
	618	6030		CONDT (PVC) (SCH 40) (3") (BORE)  DOLLARS and CENTS	LF	895.000	120

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	618	6033		CONDT (PVC) (SCH 40) (4") DOLLARS and CENTS	LF	20.000	121
	618	6047		CONDT (PVC) (SCH 80) (2") (BORE) DOLLARS and CENTS	LF	135.000	122
	618	6054		CONDT (PVC) (SCH 80) (3") (BORE) DOLLARS and CENTS	LF	310.000	123
	618	6074		CONDT (RM) (3") DOLLARS and CENTS	LF	4.000	124
	620	6007		ELEC CONDR (NO.8) BARE DOLLARS and CENTS	LF	823.000	125
	620	6009		ELEC CONDR (NO.6) BARE DOLLARS and CENTS	LF	1,035.000	126
	620	6010		ELEC CONDR (NO.6) INSULATED DOLLARS and CENTS	LF	40.000	127
	620	6015		ELEC CONDR (NO.2) BARE DOLLARS and CENTS	LF	382.000	128
	620	6016		ELEC CONDR (NO.2) INSULATED DOLLARS and CENTS	LF	764.000	129
	621	6005		TRAY CABLE (4 CONDR) (12 AWG) DOLLARS and CENTS	LF	1,110.000	130
	624	6010		GROUND BOX TY D (162922)W/APRON DOLLARS and CENTS	EA	10.000	131
	624	6012		GROUND BOX TY E (122317)W/APRON DOLLARS and CENTS	EA	1.000	132

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	ITEM NO	DESC CODE	S.P. NO.				
	628	6115		ELC SRV TY D 120/240 060(NS)AL(E)PS(U) DOLLARS and CENTS	EA	1.000	133
	628	6149		ELC SRV TY D 120/240 060(NS)SS(N)GC(O) DOLLARS and CENTS	EA	1.000	134
	636	6001		ALUMINUM SIGNS (TY A) DOLLARS and CENTS	SF	16.000	135
	636	6003		ALUMINUM SIGNS (TY O) DOLLARS and CENTS	SF	199.000	136
	644	6001		IN SM RD SN SUP&AM TY10BWG(1)SA(P) DOLLARS and CENTS	EA	2.000	137
	644	6004		IN SM RD SN SUP&AM TY10BWG(1)SA(T) DOLLARS and CENTS	EA	21.000	138
	644	6033		IN SM RD SN SUP&AM TYS80(1)SA(U) DOLLARS and CENTS	EA	2.000	139
	644	6034		IN SM RD SN SUP&AM TYS80(1)SA(U-1EXT) DOLLARS and CENTS	EA	1.000	140
	644	6064		IN BRIDGE MNT CLEARANCE SGN ASSM(TY N) DOLLARS and CENTS	EA	2.000	141
	647	6002		RELOCATE LRSA DOLLARS and CENTS	EA	1.000	142
	650	6079		INS OH SN SUP(70 FT BRDG) DOLLARS and CENTS	EA	1.000	143
	658	6001		INSTL DEL ASSM (D-SW)SZ 1(FLX)GND DOLLARS and CENTS	EA	3.000	144

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	658	6018		INSTL DEL ASSM (D-SY)SZ 1(FLX)GND DOLLARS and CENTS	EA	13.000	145
	662	6004		WK ZN PAV MRK NON-REMOV (W)4"(SLD) DOLLARS and CENTS	LF	3,008.600	146
	662	6016		WK ZN PAV MRK NON-REMOV (W)24"(SLD) DOLLARS and CENTS	LF	33.000	147
	662	6034		WK ZN PAV MRK NON-REMOV (Y)4"(SLD) DOLLARS and CENTS	LF	2,672.900	148
	662	6061		WK ZN PAV MRK REMOV (W)4"(DOT) DOLLARS and CENTS	LF	126.000	149
	662	6063		WK ZN PAV MRK REMOV (W)4"(SLD) DOLLARS and CENTS	LF	4,201.900	150
	662	6075		WK ZN PAV MRK REMOV (W)24"(SLD) DOLLARS and CENTS	LF	102.500	151
	662	6095		WK ZN PAV MRK REMOV (Y)4"(SLD) DOLLARS and CENTS	LF	6,370.800	152
	666	6030		REFL PAV MRK TY I (W)8"(DOT)(100MIL) DOLLARS and CENTS	LF	68.300	153
	666	6036		REFL PAV MRK TY I (W)8"(SLD)(100MIL) DOLLARS and CENTS	LF	3,824.100	154
	666	6042		REFL PAV MRK TY I (W)12"(SLD)(100MIL) DOLLARS and CENTS	LF	370.000	155
	666	6048		REFL PAV MRK TY I (W)24"(SLD)(100MIL) DOLLARS and CENTS	LF	804.200	156

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	ITEM NO	DESC CODE	S.P. NO.				
	666	6054		REFL PAV MRK TY I (W)(ARROW)(100MIL) DOLLARS and CENTS	EA	22.000	157
	666	6063		REFL PAV MRK TY I(W)(UTURN ARW)(100MIL) DOLLARS and CENTS	EA	2.000	158
	666	6078		REFL PAV MRK TY I (W)(WORD)(100MIL) DOLLARS and CENTS	EA	24.000	159
	666	6099		REF PAV MRK TY I(W)18"(YLD TRI)(100MIL) DOLLARS and CENTS	EA	54.000	160
	666	6138		REFL PAV MRK TY I (Y)8"(SLD)(100MIL) DOLLARS and CENTS	LF	154.400	161
	666	6167		REFL PAV MRK TY II (W) 4" (BRK) DOLLARS and CENTS	LF	625.850	162
	666	6170		REFL PAV MRK TY II (W) 4" (SLD) DOLLARS and CENTS	LF	4,596.700	163
	666	6176		REFL PAV MRK TY II (W) 8" (DOT) DOLLARS and CENTS	LF	68.300	164
	666	6178		REFL PAV MRK TY II (W) 8" (SLD) DOLLARS and CENTS	LF	3,611.100	165
	666	6180		REFL PAV MRK TY II (W) 12" (SLD) DOLLARS and CENTS	LF	370.000	166
	666	6182		REFL PAV MRK TY II (W) 24" (SLD) DOLLARS and CENTS	LF	804.200	167
	666	6184		REFL PAV MRK TY II (W) (ARROW) DOLLARS and CENTS	EA	21.000	168

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	666	6187		REFL PAV MRK TY II (W) (UTURN ARROW) DOLLARS and CENTS	EA	2.000	169
	666	6192		REFL PAV MRK TY II (W) (WORD) DOLLARS and CENTS	EA	23.000	170
	666	6198		REFL PAV MRK TY II (W) 18" (YLD TRI) DOLLARS and CENTS	EA	54.000	171
	666	6207		REFL PAV MRK TY II (Y) 4" (SLD) DOLLARS and CENTS	LF	4,210.400	172
	666	6211		REFL PAV MRK TY II (Y) 8" (SLD) DOLLARS and CENTS	LF	154.400	173
	666	6300		RE PM W/RET REQ TY I (W)4"(BRK)(100MIL) DOLLARS and CENTS	LF	699.600	174
	666	6303		RE PM W/RET REQ TY I (W)4"(SLD)(100MIL) DOLLARS and CENTS	LF	4,893.200	175
	666	6315		RE PM W/RET REQ TY I (Y)4"(SLD)(100MIL) DOLLARS and CENTS	LF	4,505.400	176
	672	6007		REFL PAV MRKR TY I-C DOLLARS and CENTS	EA	64.000	177
	672	6009		REFL PAV MRKR TY II-A-A DOLLARS and CENTS	EA	125.000	178
	677	6001		ELIM EXT PAV MRK & MRKS (4") DOLLARS and CENTS	LF	522.700	179
	677	6003		ELIM EXT PAV MRK & MRKS (8") DOLLARS and CENTS	LF	99.800	180

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	680	6002		INSTALL HWY TRF SIG (ISOLATED) DOLLARS and CENTS	EA	1.000	181
	682	6001		VEH SIG SEC (12")LED(GRN) DOLLARS and CENTS	EA	13.000	182
	682	6002		VEH SIG SEC (12")LED(GRN ARW) DOLLARS and CENTS	EA	3.000	183
	682	6003		VEH SIG SEC (12")LED(YEL) DOLLARS and CENTS	EA	13.000	184
	682	6004		VEH SIG SEC (12")LED(YEL ARW) DOLLARS and CENTS	EA	4.000	185
	682	6005		VEH SIG SEC (12")LED(RED) DOLLARS and CENTS	EA	13.000	186
	682	6006		VEH SIG SEC (12")LED(RED ARW) DOLLARS and CENTS	EA	3.000	187
	682	6018		PED SIG SEC (LED)(COUNTDOWN) DOLLARS and CENTS	EA	12.000	188
	682	6035		BACK PLATE (12")(3 SEC)(VENTED)ALUM DOLLARS and CENTS	EA	15.000	189
	682	6036		BACK PLATE (12")(4 SEC)(VENTED)ALUM DOLLARS and CENTS	EA	1.000	190
	684	6031		TRF SIG CBL (TY A)(14 AWG)(5 CONDR) DOLLARS and CENTS	LF	120.000	191
	684	6033		TRF SIG CBL (TY A)(14 AWG)(7 CONDR) DOLLARS and CENTS	LF	3,180.000	192

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	684	6042		TRF SIG CBL (TY A)(14 AWG)(16 CONDR) DOLLARS and CENTS	LF	1,470.000	193
	684	6079		TRF SIG CBL (TY C)(12 AWG)(2 CONDR) DOLLARS and CENTS	LF	3,275.000	194
	686	6043		INS TRF SIG PL AM(S)1 ARM(40')LUM DOLLARS and CENTS	EA	1.000	195
	686	6047		INS TRF SIG PL AM(S)1 ARM(44')LUM DOLLARS and CENTS	EA	1.000	196
	686	6051		INS TRF SIG PL AM(S)1 ARM(48')LUM DOLLARS and CENTS	EA	1.000	197
	686	6055		INS TRF SIG PL AM(S)1 ARM(50')LUM DOLLARS and CENTS	EA	1.000	198
	686	6167		INS TRF SIG PL AM(S)2 ARM(44-36')LUM DOLLARS and CENTS	EA	1.000	199
	687	6001		PED POLE ASSEMBLY DOLLARS and CENTS	EA	9.000	200
	687	6002		PEDESTRIAN PUSH BUTTON POLE DOLLARS and CENTS	EA	1.000	201
	688	6001		PED DETECT PUSH BUTTON (APS) DOLLARS and CENTS	EA	12.000	202
	6001	6001		PORTABLE CHANGEABLE MESSAGE SIGN DOLLARS and CENTS	DAY	522.000	203
	6010	6001		CCTV FIELD EQUIPMENT (ANALOG) DOLLARS and CENTS	EA	1.000	204

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	6010	6003		CCTV FIELD CONTROLLER DOLLARS and CENTS	EA	1.000	205
	6010	6004		CCTV MOUNT (POLE) DOLLARS and CENTS	EA	1.000	206
	6016	6006		ITS MULTI-DUCT CND (PVC-40) DOLLARS and CENTS	LF	1,152.000	207
	6016	6011		ITS MULTI-DUCT CND (PVC-80)(BORE) DOLLARS and CENTS	LF	470.000	208
	6029	6001		RADAR VEHICLE SENSING DEVICE DOLLARS and CENTS	EA	1.000	209
	6062	6018		ITS RADIO (SNGL)(5 GHZ)-I-U DOLLARS and CENTS	EA	2.000	210
	6064	6055		ITS POLE (60 FT)(90 MPH) DOLLARS and CENTS	EA	1.000	211
	6064	6092		ITS POLE MNT CAB (TY 3)(CONF 2) DOLLARS and CENTS	EA	1.000	212
	6083	6001		VIDEO IMAGING AND RAD VEH DETEC- TION SYS DOLLARS and CENTS	EA	6.000	213
	6186	6002		ITS GND BOX(PCAST) TY 1 (243636)W/APRN DOLLARS and CENTS	EA	1.000	214
	6186	6008		ITS GND BOX(PCAST) TY 2 (366036)W/APRN DOLLARS and CENTS	EA	2.000	215
	7012	6001		CURB INLET SEDIMENT PROTECTION DOLLARS and CENTS	LF	255.000	216

ALT	ITEM-CODE			UNIT BID PRICE ONLY. WRITTEN IN WORDS	UNIT	APPROX QUANTITIES	DEPT USE ONLY
	ITEM NO	DESC CODE	S.P. NO.				
	7021	6101	001	FIRE HYDRANT RELOCATE AND RECON- NECT  DOLLARS and CENTS	EA	1.000	217
	7021	6102	001	ADJUST WATER VALVE COVERS AND STACKS  DOLLARS and CENTS	EA	5.000	218

Basis of Estimate

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Item	Description	Rate	Unit
168	Vegetative Watering	169,400 gal./acre	1,000 gal.
260	Lime (Hydrated, Commercial Or Quicklime)(Slry)	150 lb./cu. yd.	Ton
275	Cement (New Base) *Road-Mix)(For Ty E, Gr-4)	81 lb./cu. yd. (2.4% by Weight)	Ton
310	Asph Mat'l (MC-30 or EC-30) (Subgrade)(Priming)	0.2 gal./sq. yd.*	Gal.
341	Hot Mix (Ty B)	115 lb./(sq. yd.-in.)	Ton
346	Stone Matrix Asphalt	115 lb./(sq. yd.-in.)	Ton

- \* Based On 50% Asphalt Residue.
- \*\* Non-Pay, for Contractor's Information Only.

Compaction Requirements for Base Courses:

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(Percent Of Density As Determined By Compaction Ratio Test TEX-113-E)

ITEM	MATERIAL	COURSE	MIN DENSITY
247	Flex Base	All	100 %

**The TxDOT Signal Shop can be reached at 817-370-3664.** Contact the Signal Shop for notification of pre-construction or work order meetings, delivery of equipment, request for electrical inspection, placing signals into flash or turn on, or set up of signal detection.

Provide a qualified technician, approved by the Engineer, on the project site to place the traffic signals in flash or in full operation. A qualified TxDOT signal technician must also be present.

Electronic submittal of shop drawings, working drawings, equipment manuals and product brochures is permitted for this project.

The contractor is responsible for picking up materials furnished by the State. Contact the TxDOT Signal Shop 48 hours in advance of picking up to make arrangements.

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**Special Notes:**

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Electronic files containing answered pre-letting questions and other project related design information will be placed in the following FTP site periodically.

It is the responsibility of the contractor to check this site for new information. Notices of new postings will not be sent out.

The data located in these files is for non-construction purposes only.

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Instructions for using the FTP Site:

From Internet Explorer, do the following:

Go to [FTP://ftp.dot.state.tx.us](ftp://ftp.dot.state.tx.us)

Click Page>Open FTP site in Windows Explorer

Click File>Login As

Enter the Username and password given below and click "Log on".

.....

FTP USERNAME: ftwstaor

FTP PASSWORD: 8wseskt

Access is read-only

All files in the FTP site are subject to the License Agreement shown on the FTP site. If you wish to obtain a copy of the project plans you may do so, free of charge from the following site.

<http://www.txdot.gov/business/letting-bids/plans-online.html>

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Personnel will be experienced in items of work in contract. Safety vests and hard hats will be pre-approved and worn at all times when outside vehicles within the work area.

Contract Prosecution: Each contract awarded by the Department stands on its own and as such, is separate from other contracts. A Contractor awarded multiple contracts must be capable and sufficiently staffed to concurrently process and/or execute all contracts at the same time.

Pavement markers will be left in place until such time as they are in conflict with the work in progress.

Referencing of all existing striping and pavement markings prior to beginning paving operations shall be the contractor's responsibility.

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All pavement markings and/or striping that are in conflict with traffic operations will be removed by the contractor. Such removal will be considered subsidiary to the various bid items, and will not be paid for directly.

Calculating, Recording and Reporting Test Data - Use appropriate TxDOT Excel templates to calculate and record all test data. These forms are available on the TxDOT website at <http://www.txdot.gov/inside-txdot/forms-publications/consultants-contractors/forms/site-manager.html> under the "Site Manager Forms" heading. Submit test results by email or CD within 24 hours of test completion.

No work will be permitted to commence on the road before sunrise or after sunset except as shown in the plans or as directed by the engineer. Single lane closures, except as otherwise shown in the plans, will be restricted to off-peak hours as defined in the following table:

Peak Hours		Off-Peak Hours	
6 to 9 AM Monday through Friday	4 to 7 PM Monday through Friday	9 AM to 4 PM and	All day Saturday and Sunday

Existing storm sewers and utilities are shown from the best available information. Verify the location of all underground facilities prior to starting work.

For dimensions of right of way not shown on the plans, see right of way map on file at the TxDOT District Office.

Take care that existing curb and curb and gutter is not discolored or damaged during construction operations. In the event of discoloration or damage, clean or repair as directed.

Remove all existing fences within the right of way and remove and replace all existing fences within easements where such fences conflict with the work. Protect the remaining fence from damage due to slacking. Erect temporary fencing in the easement areas as necessary to secure the property. Provide at least one week notice to the property owner prior to removing or relocating the fence. Restore permanent fencing to an equal or better condition.

Provide all-weather surface for temporary ingress and egress to adjacent property, as directed. Materials, labor, equipment and incidentals necessary to provide temporary ingress and egress will not be paid for directly, but will be subsidiary to the various bid items.

Where necessary, the governing slopes indicated herein may be varied from the limits shown, to the extent approved.

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All driveway openings will be determined by the Engineer and will conform with Texas Department of Transportation "Regulations for Access Driveways to State Highways" adopted September 1953, and revised June 2004.

Locations and lengths of all private entrances are approximate only. The actual locations, lengths, lines, and grades are to be established in the field.

Locations shown for drainage structures refer to the control points of structures as follows:

- 1) Manholes, Inlets, and Junction Boxes—Locations are at the centroid of the structure; when two structure types are specified, location is at the centroid of the bottom structure. Top structure may be positioned as required to align with bottom structure, storm drain pipes and other adjacent structures.
- 2) Street Inlets—Locations are at the face of curb at a distance of L/2 from the end of the inlet.
- 3) Headwalls—Locations are to the outside face of the headwall at the centerline of the pipe or box structure. For pipe headwalls with Type "P" or "C" safety end treatment, locations are on the centerline of the pipe structure at the limit of payment for pipe.

Plugging of pipes or culverts will not be paid for directly, but will be subsidiary to the various bid items, unless otherwise shown on the plans.

Provide temporary drain openings at all low points or other drainage structures, as required, at the Contractor's expense.

Install all required concrete riprap flumes immediately following the construction of ditches in which they are to be placed. In addition, apply all erosion control measures as shown on the plans or as directed, immediately following construction of channels to their required line, grade, and section.

Notify Traffic Management Division (817-392-7738) at least one week prior to starting work on Traffic Signals.

Notify Traffic Management Division (817-392-7738) Project Representative at least 24-hours in advance of all concrete pours. Inspector must be present when concrete is placed on the project site unless prior written approval has been provided.

Equipment supplied by the City will be available for pick up from the Transportation/Public Works (T/PW) Warehouse at 5001 James Avenue and/or the Village Creek Pole Yard (5000 MLK Freeway). The Project Representative must authorize all equipment pickups.

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## **Item 2. Instructions to Bidders**

Proposals with a bid of more than **363** working days for the substantial completion of the project will be considered non-responsive.

## **Item 5. Control of the Work**

When supplementary bridge plans, shop drawings, shop details, erection drawings, working drawings, forming plans, or other drawings are required, the drawings will be prepared and submitted on sheets 8-1/2 by 11 inches, 17 by 22 inches, or full size drawings reduced to half scale if completely legible. If, in the opinion of the Engineer, the drawings are not completely legible, they will be prepared and submitted on sheets 22 by 34 inches, with a 1-1/2 inch left margin, and 1/2 inch top, right, and bottom margins.

All sheets submitted will have a title in the lower right hand corner. The title must include the sheet index data shown on the lower right corner of the project plans, name of the structure or element or stream, sheet numbering for the shop drawings, name of the fabricator and the name of the Contractor.

Prior to contract letting, bidders may obtain a free computer diskette or a computerized transfer of files (from the Engineer's office) that contains the earthwork information in ASCII format, plain text files. If copies of the actual cross-sections are requested, in addition to, or instead of the diskette, they will be available at the Engineers office for borrowing by copying companies for the purpose of making copies for the bidder, at the bidder's expense.

The locations of all signal related items, pavement markings, signing, etc. are diagrammatic only and may be adjusted to accommodate field conditions or as directed by Engineer.

## **Item 7. Legal Relations and Responsibilities**

Do not initiate activities in a project specific location (PSL) associated with a U.S. Army Corps of Engineers (USACE) permit area that has not been previously evaluated by the USACE as part of the permit review of this project. Such activities include, but are not limited to haul roads, equipment staging areas, borrow and disposal sites. "Associated" as defined here means materials are delivered to or from the PSL. The permit area includes all waters of the U.S. or associated wetlands affected by activities associated with this project. Special restrictions may be required for such work. The contractor will be responsible for all consultations with the USACE regarding activities, including project specific locations (PSLs) that have not been previously evaluated by the USACE. Provide the Department with a copy of all consultations or approvals from the USACE prior to initiating activities.

The Contractor may proceed with activities in PSLs that do not affect a USACE permit area if a self determination has been made that the PSL is non-jurisdictional or proper USACE clearances

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have been obtained in jurisdictional areas or have been previously evaluated by the USACE as part of the permit review of this project. The contractor is solely responsible for documenting any determinations that their activities do not affect a USACE permit area. Maintain copies of these determinations for review by the Department or any regulatory agency.

Document and coordinate with the USACE, if required, prior to any excavation hauled from or embankment hauled into a USACE permit area by either (1) or (2) below.

- (1) Restricted Use of Materials for Previously Evaluated Permit Areas.** Document both the project specific location (PSL) and its authorization. Maintain copies for review by the Department or any regulatory agency. When an area within the project limits has been evaluated by the USACE as part of the permit process for this project:

  - a. Suitable excavation of required material in the areas shown on the plans and cross sections as specified in Item 110 is used for permanent or temporary fill (Item 132, Embankment) within a USACE permit area;
  - b. Suitable embankment (Item 132) from within the USACE permit area is used as fill within a USACE evaluated area; and,
  - c. Unsuitable excavation or excess excavation [“Waste”] (Item 110) that is disposed of at a location approved by the Engineer within a USACE evaluated area.
- (2) Contractor Materials from Areas Other than Previously Evaluated Areas.** Provide the Department with a copy of all USACE coordination or approvals prior to initiating any activities for an area within the project limits that has not been evaluated by the USACE or for any off right of way locations used for the following, but not limited to haul roads, equipment staging areas, borrow and disposal sites:

  - a. Item 132, Embankment, used for temporary or permanent fill within a USACE permit area; and,
  - b. Unsuitable excavation or excess excavation [“Waste”] (Item 110, Excavation) that is disposed of outside a USACE evaluated area.

The total area disturbed for this project is 11.3 acres. The disturbed area in this project, all project locations in the Contract, and the Contractor project specific locations (PSLs), within 1 mile of the project limits, for the Contract will further establish the authorization requirements for storm water discharges. The Department will obtain an authorization to discharge storm water from the Texas Commission on Environmental Quality (TCEQ) for the construction activities shown on the plans. The Contractor is to obtain required authorization from the TCEQ for Contractor PSLs for construction support activities on or off the right of way. When the total area disturbed in the Contract and PSLs within 1 mile of the project limits exceeds 5 acres, provide a copy of the Contractor NOI for PSLs on the right of way to the Engineer and to the local government that operates a separate storm sewer system.

**Item 8. Prosecution and Progress**

Working days will be computed and charged in accordance with Section 8.3.1.1, 'Five-Day Workweek.'

Work is allowed to be performed during the nighttime.

The number of working days for final acceptance will be 30 working days after the substantial completion of the project.

Provide a 48 hour advance notice for work on Saturday. Work on Sundays and national holidays will not be permitted without written authorization.

**Item 8.9 Workers and Equipment**

Provide Multi-Directional Lighting Device for nighttime work with the following quality requirements:

- Provide a 2000 watt (minimum) SIROCCO lighting balloon, Airstar lighting or equivalent.
- It is the intent of the MDLD lighting to supplement the Portable Road Light and Power Unit used to illuminate work areas during night work hours.
- Provide MDLD units which can self-inflate and are capable of illuminating approximately 15,000 sq.ft.
- Provide MDLD units of 1.1 meter horizontal diameter and capable of withstanding 60 mph winds when fully inflated and operating.
- Provide MDLD units with two (2) 1,000 watt halogen bulbs recommended by the manufacturer.

**Item 100. Preparing Right of Way**

Measurement for this item will be along the centerline of the project with the limits of measurements as shown on the plans.

Centerlines of Chapel Creek Blvd, EB Ramp/Frontage Road and WB Ramp/Frontage Road are used for measurement and shall include all Preparing Right of Way within the project limits including IH 30.

Removal of small road sign supports and assemblies shall be included in the cost of Item 100.

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**Item 104. Removing Concrete**

When associated with a structure to be removed, removal of riprap as required, approach slabs, and shoulder drains are to be included in the unit price bid for Item 496, “Removing Structures.”

**Item 110. Excavation**

Review proposed waste sites to determine if any site is located in a “Base Floodplain” or “Floodway” as defined by the Federal Emergency Management Agency (FEMA).

If waste material from this project is placed in a base floodplain as defined by FEMA, a permit will have to be obtained from the local community responsible for enforcing National Flood Insurance Program (NFIP) regulations. The Contractor is responsible for ensuring that the owner of the property receiving the waste has obtained the necessary permit.

**Items 110, 112, and 132. Excavation, Subgrade Widening, and Embankment**

Sulfate-laden subgrade material that is to be treated with either lime or cement, including material up to one foot outside the proposed treatment limits, is susceptible to sulfate heave. It has been determined that an excessive concentration of sulfate in the soils (>3,000 PPM by dry weight of the soil) exists for given areas of excavation and/or proposed treated subgrade within the project limits. The areas of moderate to high concentrations are as follows:

Areas of subgrade to be treated (3,001–7,000 PPM—moderate concentration)

no areas identified

Areas of excavation (>7,000 PPM—high concentration)

no areas identified

Moderate sulfate levels are those defined from 3,001 PPM to 7,000 PPM. Treat these soils with lime at the full 150 lb./cu. yd. rate or cement at the full 125 lb./cu. yd. rate. Do not split the rates to ensure complete reaction and mitigation of sulfate heaves. Allow the mixture to mellow for 7 days to provide for complete reaction.

High sulfate levels are not allowed within the treatment and surrounding areas as defined above.

Test soils for soluble sulfates in accordance with Test Method Tex-145 and Tex-146-E.

Treat moderate sulfate or excavate high sulfate areas identified above and other subgrade areas that may be identified during construction as having moderate to high sulfate concentrations to a depth of one foot below and laterally to one foot outside the proposed treatment limits.

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Treatment of the moderate level material will be paid for under Item 260, "Lime Treatment (Road Mixed)" or Item 275, "Cement Treatment (Road Mixed)." Removal of the high level material will be measured and paid for in accordance with Item 110, "Excavation" and replacement with suitable material will be measured and paid for in accordance with Item 132, "Embankment."

Any excavated sulfate-laden material will be acceptable for use in fill areas. Do not place within previously specified section boundaries of subgrade to be treated with either lime or cement.

Off-Site Borrow Sources. In addition to meeting pertinent specification requirements, test off-site borrow sources for sulfate content. Test soils for soluble sulfates in accordance with Test Method Tex-145 and Tex-146-E and provide documentation that supports compliance with previously stated requirements. The Engineer will perform additional testing for sulfates of this material upon delivery to the project. Only material that is placed within one foot vertically or laterally of subgrade treatment will require testing for sulfates. Remove and replace failing material (sulfate concentrations >7,000 PPM by dry weight).

### **Item 132. Embankment**

Furnish test results per Test Procedures Tex-104, 105, and 106-E (PIs), Tex-113 or 114-E (M-D Curves), and Tex-145 and/or Tex-146-E (Sulfates) for each material sample provided by the Engineer. Perform field density tests (Tex-115-E, Part I) at a frequency for each worked section to produce passing results prior to testing by the Engineer per Tex-115-E, Part I.

When embankment is placed as a bridge header bank, test each lift for compliance with density requirements, near the center of each travel lane at the following locations:

1. At the "beginning of bridge" or "end of bridge" station (if abutment is on retaining wall, location may be adjusted by not more than 5 feet.)
2. At 25-foot intervals for a distance of 150 feet in advance of the "beginning of bridge" station.
3. At 25-foot intervals for a distance of 150 feet after the "end of bridge" station.

Density tests must be conducted by a department-certified independent testing laboratory. Results of tests will be furnished to TxDOT within 24 hours after testing; a final copy of all test reports must be signed and sealed by a Professional Engineer in the State of Texas and furnished within five (5) working days after testing. Areas which do not meet minimum density requirements will be removed, re-compacted, and re-tested for compliance at the contractor's entire expense. Testing and reporting of test results will not be paid for directly, but will be subsidiary to this item.

Construct embankments for bridge header banks to final subgrade elevation prior to excavation for abutment caps and placement of foundation course at approach slabs.

Payment for structural excavation and/or excavation for placement of foundation course will not be paid for directly, but will be subsidiary to the pertinent bid items.

At all locations where guardrail is shown to flare, widen the embankment as necessary to accommodate the guardrail.

**Item 161. Compost**

Place approximately 4" of compost manufactured topsoil (CMT) on all cut and fill slopes (except drainage channels where flexible channel liners are indicated), at other locations shown on the plans, or as directed.

**Item 162. Sodding for Erosion Control**

Furnish and place Bermudagrass sod.

**Item 164. Seeding for Erosion Control**

Apply seeding required between December 1 and January 31 using seed types and mixtures as shown in Item 164.2.1, Table 3. If, in the opinion of the Engineer, this does not provide an effective vegetative cover, apply "straw or hay mulch" as specified in Article 164.3.2, "Straw or Hay Mulch Seeding" as soon as possible. After February 1 apply warm season seeding in order to establish a permanent protective vegetative cover.

**Item 168. Vegetative Watering**

Furnish and install an approved rain gauge at the project site, as directed. Furnishing and installation of the rain gauge will not be paid for directly, but will be subsidiary to Item 168.

Apply vegetative watering for an establishment period of thirteen weeks following application of seed or installation of sod, at a rate of 1/2 inch of water depth per week (approximately 13,030 gallons per acre). During the first four weeks after seeding, apply water twice per week, on non-consecutive days, each at half the weekly application rate. For the remainder of the establishment period, apply vegetative watering once per week during the months of January through June or September through December, at the weekly application rate; apply watering twice per week, on non-consecutive days during the months of July and August, each at one-half the weekly application rate.

Average weekly rainfall rates for the District are:

January—0.39"	April—0.86"	July—0.48"	October—0.68"
February—0.46"	May—1.00"	August—0.47"	November—0.46"
March—0.48"	June—0.63"	September—0.74"	December—0.37"

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**Item 247. Flexible Base**

(TY E, GR 4) Use this item for the foundation course under the approach slabs and other locations shown on the plans. Crushed concrete will not be allowed. Furnish aggregate conforming to the following requirements:

Gradation:

<u>Sieve Size</u>	<u>Percent (%) by Weight</u>
1-3/4 in.	0 – 5
No. 4	30 – 75
No. 40	65 – 85

Plasticity Index (PI)	15 max.
Liquid Limit	45 max.
Wet Ball Mill	50 max.
Wet Ball Mill, %	20 max.
Increase Passing the No. 40	

Place material in two or more equal lifts not to exceed 8” unless otherwise directed.

Do not add field sand to modify the final material to meet the requirements.

Cement treat in accordance with Item 275.

**Item 260. Lime Treatment (Road-Mixed)**

Apply lime by the “slurry placement” method. Allow the mixture to mellow for a minimum of 4 days after initial mixing. If moderate sulfates are present, or for other extenuating circumstances as determined by the Engineer, allow the mixture to mellow for 7 days after initial mixing.

Treat the raw subgrade to a depth of 8".

Treat the raw subgrade with lime to a depth of 18" for:

- Fills equal to or greater than 18"—soil PI > 39
- Fills <18"—soil PI >29
- All cuts—soil PI > 29
- Any location directed by the Engineer

Build stockpiles between 10 and 15 feet in height with layers approximately 2 feet in depth.

**Item 275. Cement Treatment (Road-Mixed)**

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Apply cement for subgrade treatment by the “slurry placement” method. Treat flexible base for bridge approach slab foundation course with 2.4% cement by weight.

If the Contractor elects to plant-mix cement with the foundation course, mix in accordance with Articles 276.3 and 276.4.A. Place the mixture in accordance with Article 276.4.B and compact in accordance with Article 276.4.C.

**Item 301. Asphalt Antistripping Agent**

Furnish a liquid antistripping agent unless directed when required by the design. The Engineer will verify the requirement prior to approval of the design.

**Item 305. Salvaging, Hauling, and Stockpiling Reclaimable Asphalt Concrete**

All Reclaimable Asphalt Concrete will become the property of the Contractor and shall be removed immediately.

Do not add field sand to modify the final material to meet the requirements.

**Item 310. Prime Coat**

Provide an MC-30 or EC-30 for this Item.

**Item 341. Dense-Graded Hot-Mix Asphalt**

In Table 1, the Micro-Deval abrasion test is not required.

RAP and RAS are not permitted in any surface and levelup mixes on this project.

RAP aggregate for the base and underlayment courses must meet the requirements of Table 1.

Provide a PG 64-22 asphalt for the base and concrete underlayment courses.

Provide a PG 70-28 asphalt for the surface course and/or levelup course. Provide the PG 70-28 asphalt with either of the following modification alternatives:

- \* PG 64-22 modified with 3% solids by dry weight of SBR Latex polymer at the Hot Mix plant.
- \* AC-10 modified with 3% solids by dry weight of SBR Latex polymer at the Hot Mix plant.

When the asphalt is modified at the Hot Mix Plant, provide the PG 64-22 or AC-10 refinery certification.

Grade Substitution per Table 5 is not allowed.

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The Engineer will evaluate the results of the PG 70-28 asphalt/SBR Latex blend but not for acceptance.

Furnish a CSS-1P with greater than 50% asphalt residue for the tack coat on this project.

Use the following notes when using Warm Mix Asphalt (WMA):

Notify the District Pavement Design Engineer (Faisal Abdel-Qader, P.E; Faisal.AbdelQader@txdot.gov ) with the following information:

1. Project CSJ,
2. pavement layer/location (surface, base, shoulder level-up, other) with the corresponding thicknesses,
3. mix type (Type A, B, C, D, or F),
4. approximate tonnage used for each application, and
5. WMA additive process used from the TxDOT Material Producer List available at <http://ftp.dot.state.tx.us/pub/txdot-info/cmd/mpl/wma.pdf>.

Use any approved "Chemical Additive" for all mix applications. Use an approved system to measure and produce a recorded printout of the amount of WMA additive going into the mix. Delivery temperature shall be a maximum of 235° F. Delivery and roll out temperatures will be modified by the Supplier and accepted by the Engineer. All work related to WMA product additives is subsidiary to this item.

An authorized representative of the WMA product additive supplier will be present onsite during the first day of asphalt placement.

Substitute binders are not allowed on this project.

A pre-paving meeting with the Engineer is not required for this project.

Use only the Superpave Gyrotory Compactor (SGC) to design the mixture.

Use the Boil Test, Test Procedure Tex-530-C, and provide only mixes that produce zero percent (0%) stripping for design verification and during production.

For Table 10, the Minimum Number of Passes required for the High-Temperature Binder Grade of PG 70-28 is reduced by 5,000 passes for all mixes used in areas other than the surface.

Include the approved mix design number on each delivery ticket.

Use a Material Transfer Device (MTD) unless otherwise directed.

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Use Surface Test Type B Schedule 2 for this project.

**Item 360. Concrete Pavement**

Furnish a CSS-1P with greater than 50% asphalt residue for the tack coat on this project.

When using the Hardy Chair-Lok to support reinforcing steel, chair spacing may be increased to 1.67 sq. yd. per chair, placed in a diamond or square pattern. Do not exceed 60" longitudinal spacing.

Include the approved mix design number on each delivery ticket.

**Item 400. Excavation and Backfill for Structures**

Class B bedding will be permitted in lieu of Class C bedding.

**Item 402. Trench Excavation Protection**

Trench protection will required for all pipe, box, and structural elements of storm drain installation unless otherwise noted or directed by the engineer.

**Item 403. Temporary Special Shoring**

Temporary shoring for construction of retaining walls must be designed to prevent build-up of water pressures behind shoring.

Temporary shoring design shall take into account all external loading conditions including temporary earth wall, traffic surcharge, etc.

The Contractor may elect to remove all, or a portion of, the temporary shoring material. The removal must be effected in such a manner as not to disturb the retained soil or adjacent structures. Any portion of the temporary shoring left in place must be removed to minimum depth of two (2) feet below the finished subgrade or to four (4) feet below finished ground.

**Item 416. Drilled Shaft Foundations**

Stake locations and have them approved by the inspector before installation of foundations. This will ensure that all luminaires and mast arms are clear of all overhead lines and underground utilities **before** drilling begins. The signal inspector together with the contractor will calculate the vertical signal head clearance before placing any traffic signal pole foundation.

Notify the TxDOT Signal Shop and Inspector 48 hours prior to forming and placing concrete in any unit of all the Signal Pole and Controller Foundations. Do not place concrete without an

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Inspector present unless approved. Failure to inform the Inspector and provide adequate time to arrive on the job site may result in removing and replacing the foundation.

**Item 420. Concrete Structures**

Provide weep holes at bridge ends in the wing walls as directed.

Concrete for "Interior Bents" will be paid for as a plan quantity.

The district survey department will provide two bronze ROW Markers per bridge to be cast into the bridge concrete at a location determined by the engineer or the district survey department.

**Item 421. Hydraulic Cement Concrete**

For Class P and S Concrete Only: For concrete plants equipped with 2 aggregate bins or no calibrated metering system, blend manufactured and natural sand at the aggregate source only. For concrete plants equipped with a minimum of 3 bins and a calibrated metering system, blending of the separate sands on-site is permitted to meet gradation and AIR requirements.

Strength/cylinder testing equipment must be equipped with a printer for an electronic print out of all test results.

Air entrainment requirements are waived for all classes of concrete except all Class S and all Class P concrete.

Concrete will not be rejected for low air content. Adjustment to the dosage of air entrainment will be as directed or allowed by the Engineer.

Include the approved mix design number on each delivery ticket.

Contractor personnel performing job-control (QC) testing on concrete must be ACI certified and maintain certification. Provide a copy of all personnel certification papers to the Engineer at the preconstruction meeting. The Engineer may require the Contractor's testers to provide the certification papers upon arrival and before testing at the job site. Certified testers will be required to participate with certified TxDOT personnel annually for slump (Tex-415-A), air content (Tex-416-A), compression testing (Tex-418-A), and capping cylinders (Tex-450-A) to retain their certification on TxDOT projects.

Furnish a hard copy of all testing equipment calibration reports at the preconstruction meeting when non-TxDOT equipment is used to test concrete. Furnish updated reports as equipment is calibrated through the project contract. The calibration frequency will match TxDOT's and will apply for each piece of equipment as follows:

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Slump Cone - Annual  
Air Meter - Every 3 months  
Compression Tester - Annual  
Beam breaker - Annual

The Engineer may allow the use of local commercial laboratories under contract to provide these services. The Commercial Laboratory must fulfill requirements listed above prior to performing any work.

Do not place concrete for paving, approach slabs, or bridge slabs when anticipated weather conditions will result in a predicted evaporation rate above 0.3 ft<sup>2</sup>/hr. as determined using the Portland Cement Association (PCA) publication Design and Control of Concrete Mixtures, Figure 13-8.

#### **Item 423. Retaining Wall**

The following Mechanically Stabilized Earth (MSE) panel type systems are approved for use on TxDOT projects:

<http://www.txdot.gov/inside-txdot/division/bridge/approved-systems/mse-wall.html>

TY AS backfill shall be used.

#### **Item 427. Surface Finishes for Concrete**

Provide Surface Area I with rub finish on all overpass structures.

#### **Item 432. Riprap**

Provide weep holes as directed.

The quantities for riprap at the location indicated may be varied to the extent necessary to ensure proper functioning for the purpose intended.

All concrete riprap will be 5" (.42') in thickness, unless otherwise shown on the plans, and must be reinforced.

An 8 inch (.67 ft.) by 18 inch (1.5 ft.) toe wall is required at the exposed edges of all concrete riprap, unless otherwise directed.

Locations and lengths of riprap flumes shown on the plans are approximate. Actual lengths and locations are to be determined in the field.

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When synthetic fiber reinforcement concrete option is chosen provide the following:

- At all construction joints (vertical or horizontal) provide #3 bars 24 in. long and placed on 18 in. centers along joint length. Bars should be centered in concrete cross section.
- At all toe wall locations #3 L-bars will be required on 18 in. centers with a length 2 times the depth of the toe wall. Place three #3 bars the length of the toe wall and equally spaced on the L-bars.

Welded Wire Reinforcement (WWR) may be used for construction joint and toe wall reinforcing with the approval of the Engineer.

**Item 440. Reinforcing Steel**

Top and bottom layers of slab reinforcing steel shall be epoxy coated.

**Item 464. Reinforced Concrete Pipe**

All bends and connections in pipe must be prefabricated.

**Item 479. Adjusting Structures**

The Engineer will coordinate with the City of Fort Worth on all issues related to the City of Fort Worth Water and Wastewater utilities. The Contractor has the option of requesting a list of pre-qualified Water and Wastewater Contractors by contacting John Kasavich with the City of Fort Worth Water Department at (817) 392-8480, or by email at [john.kasavich@fortworthgov.org](mailto:john.kasavich@fortworthgov.org).

Contractor shall provide as-built information and close-out documents to the Engineer per City of Fort Worth specifications 01 78 23 – Operation and Maintenance Data and 01 78 39 – Product Record Documents for all work related to City of Fort Worth water and sanitary sewer line relocations. Engineer shall prepare and provide as-built record drawings and close out documents to the City of Fort Worth upon completion of work.

1. The contractor shall be responsible for locating all utilities, whether public or private, prior to excavation. The information and data shown with respect to existing underground facilities at or contiguous to the site is approximate and based on information furnished by the owners of such underground facilities or on physical appurtenances observed in the field. The owner and engineer shall not be responsible for the accuracy or completeness of any such information or data. The contractor shall have full responsibility for reviewing and checking all such information and data, for locating all underground facilities, for coordination of the work with the owners of such underground facilities

during construction, and for the safety and protection thereof and repairing any damage thereto resulting from the work. The cost will be considered subsidiary to the contract unit price of the pipe. The contractor shall notify any affected utility companies or agencies in writing at least 48 hours prior to construction.

2. Only those items listed in the bid form will be measured and paid for at the unit price. All other work will be considered subsidiary and will be included in the unit price for the various bid items. See City of Fort Worth Specification 33 12 40 – Fire Hydrants, Section 1.2.3. This work shall include disconnect, plug and connection to existing water mains for the fire hydrant relocation.
3. The contractor shall attend monthly meetings, if necessary, with the City to review project status, traffic control, and water line shut downs and tie-ins. The following are required to attend: superintendent, contractor's project foreman.
4. Water service must be maintained at all times. One shut down will be allowed for any water customer. Shut downs shall be in accordance with the sequencing and shut down provided in these plans. Any construction issue that causes the unplanned disruption in service must be resolved as soon as possible. The contractor shall notify John Kasavich at (817) 392-8480. The contractor's crews may not leave the site until the service is restored.
5. Utility services must be maintained at all times. Any construction issue that causes the disruption in the service must be resolved as soon as possible. The contractor shall notify John Kasavich at (817) 392-8480, and the utility service contact. The contractor's crews may not leave the site until the service is restored.
6. In the event of discrepancy in the plans the contractor shall immediately notify the City inspector, the City project manager (John Kasavich), and the engineer. The engineer will clarify the design intent and instruct the contractor on how to proceed.
7. The contractor shall be responsible for following the general intent of the sequencing as shown in these plans. The sequencing is not an all inclusive list of the items that will be required to complete the work. The contractor shall follow the order of sequencing as stated in the plans. The intent of sequencing is to maintain water service in the existing transmission system. The contractor may use multiple crews to accomplish the work. The contractor shall submit a written plan to use multiple crews and any changes made to the sequencing. The City shall have the sole authority to determine if the intent of the sequencing and traffic control are maintained.

8. The contractor shall video all potentially impacted private property areas prior to work. Videos shall include date notation and audio identification of property address and main/lateral name. This pre-construction video taping of impacted properties shall be considered subsidiary to the cost of the project.
9. Contractor shall refer to City of Fort Worth design criteria standards for water and sanitary sewer details, unless otherwise specified. Details included in the plans are to assist the contractor with measurement and materials for the various City of Fort Worth items and do not imply additional bid items or compensation.
10. The proposed pipeline may, at times, be laid close to other existing utilities and structures both above and below ground. The contractor shall make necessary provisions for the support and protection of all utility poles, gas mains, telephone cables, water lines, cables, drainage pipes, utility service, and all other utilities and structures both above and below ground during construction. The contractor shall be responsible for all damage done to such existing facilities as a result of the contractor's operations.
11. The connection between proposed water lines and existing transmission water lines shall be made between Feb. 1 and April 15, or Oct. 1 and Nov. 30, or as directed by the Fort Worth Water Department. No connections to existing water lines will be allowed to be performed between April 15 and Sept. 30. Should the contractor be required to remobilize to perform these connections, no separate payment will be allowed for this item.
12. Contractor shall install water and sanitary sewer line markers per specification 33 05 26.
13. Final adjustment of manhole castings, valve vaults, meter boxes, and other at-grade appurtenances shall take place after all roadwork is complete.

CONTACT INFORMATION FOR CITY OF FORT WORTH:

CITY OF FORT WORTH  
 JOHN KASAVICH                      817-392-8480

CITY OF FORT WORTH  
 (FIELD OPERATIONS)  
 RUSSEL CURLE                      817-392-2622  
 ROGER HAUSER                      817-925-2360

CITY OF FORT WORTH (LOCATES)

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WATER AND SEWER	817-392-8296
CITY AND TRAFFIC	817-392-7738

**Item 496. Removing Structures**

Notify the Texas Department of State Health Services (DSHS) prior to demolition or renovation of bridges or other structures, using DSHS Form APB#5, "Demolition/Renovation Notification Form". The form and instructions may be found on the DSHS Asbestos Programs Branch web page at <http://www.dshs.state.tx.us/asbestos/notification.shtm>. The DSHS notification form must be hand-delivered or mailed to (received at) the DSHS Austin office at least ten working days (10) days prior to commencing demolition or renovation. Fax or e-mail notifications will not be accepted. For projects with multiple bridges, a single notification, with a listing of all bridges or structures to be demolished or renovated and the expected start dates of their demolition or renovation (the start date is defined as the first date of visible demolition activities). Notify the DSHS Regional or Local inspector of all start date changes. The expected project completion date may be used as the "end" date.

Removal of riprap as required, approach slabs and shoulder drains to be included in the unit price bid.

When required by the plans, partial or complete removal of a structure for staged construction shall be accomplished in a manner which does not cause damage to the remainder of the structure or its supporting members. Submit the procedure for removal of superstructure or substructure in writing or plan drawing for approval prior to implementation.

**Item 502. Barricades, Signs, and Traffic Handling**

The contractor force account "safety contingency" that has been established for this project is intended to be utilized to be for work zone enhancements, to improve the effectiveness of 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 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.

Permanent signs may be installed when construction in an area is complete and they will not conflict with the traffic control plan for the remainder of the job.

Existing signs are to remain as long as they do not interfere with construction and they do not conflict with the traffic control plan.

Any sign not detailed in the plans but called for in the layout will be as shown in the current "Standard Highway Sign Designs for Texas".

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When traffic is obstructed, arrange warning devices in accordance with the latest edition of the "Texas Manual on Uniform Traffic Control Devices".

Cover or remove any work zone signs when work or condition referenced is not occurring.

Do not place barricades, signs, or any other traffic control devices where they interfere with sight distance at driveways or side streets. Provide access to all driveways during all phases of construction unless otherwise noted in the plans or as directed.

Equip vehicles and equipment with at least one (1) omni-directional flashing amber warning lamp. Mount a warning lamp on the vehicles in such a manner as to allow clear visibility from all directions. Equipment such as trucks, trailers, autos, etc, will be equipped with emergency flashers and the flashers will be used within the work zone. Equipment and vehicles will be approved prior to use. Flashing Arrow Panel Boards will be Type C for this project. Shadow vehicles equipped with Truck-Mounted Attenuators (TMA's) are required as shown on all Traffic Control Plan (TCP) Standards and are considered incidental to Item 502. Striping will be required on the back panel of truck mounted attenuators, and will be 8 inches of red and white stripes placed on an inverted "V" design. Sheeting will conform to departmental material Specification D-9-8300, Type "C".

Night time closures will require the use of drums instead of grabber cones.

Nighttime closures will require off-duty uniformed police officer(s) in marked police vehicle(s) with jurisdiction and full police powers in the city or county where the work is being performed. Use of off-duty uniformed officer(s) during daytime closures will have prior approval. Number of officers will be determined and agreed upon in advance of the work.

Off-duty officers will be paid for by Force Account. Form 318 "Daily Report on Law Enforcement" shall be filled out by the contractor to check against invoice for officers. All other traffic control will be subsidiary to the various bid items.

Portable Changeable Message Signs(PCMS) shown on the Traffic Control Plan sheets (TCP's) as "optional" will be required on this contract.

**Item 504. FIELD OFFICE AND LABORATORY**

Furnish the following structures for this project:

<u>Type</u>	<u>No.</u>
Field Office and Lab (Ty. B)	1

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Field office will require at least a 3' by 3' landing on the outside of each exit door and a concrete landing at the bottom of exit stairs. The concrete landing shall be the width of the stairs and extend at least 4' in front of the bottom step.

Furnish a copier and facsimile meeting the requirements of DMS-10101, "Computer Equipment".

Furnish the following for the Field Office structure:

<u>Item</u>	<u>No.</u>
Desktop Microcomputer	1
Laptop Microcomputer	1
Printer	1
Internet Service	1

Laptop Microcomputers shall have an Intel i3 (1.5 GHz) processor, or better.

Integrated printer/copier/scanner/fax units will be permitted.

**Item 506. Temporary Erosion, Sedimentation, and Environmental Controls**

Remove accumulated sediment or replace SW3P controls when the capacity has been reduced by 50% or when the depth of sediment at the control structure exceeds one foot.

SW3P permit posting sign is considered subsidiary to this item and will be produced and installed according to SW3P standard.

**Item 512. Portable Concrete Traffic Barrier**

Traffic barrier for this item will be picked up, and returned to the stockpile at the interchange of IH 20 and Little Road in Tarrant County.

Provide the hardware assemblies to join barrier sections, including barrier from stockpile. Slotted joints require a welded tie bar assembly, as detailed on the PCTB standard detail sheet. Lapped-end PCTB requires a 1" x 1'- 4" threaded rod, two 1" hex nuts, and two 3" x 3" x 1/4" plate washers.

Connection hardware will remain the property of the State upon completion of the project and will not be paid for directly, but is subsidiary to Item 512, "Portable Concrete Traffic Barrier." Deliver hardware to the location specified.

Delineate all barrier in accordance with Barricade and Warning Sign (BC) Standards. Barrier delineation will not be paid for directly, but will be subsidiary to this Item.

Replace any traffic barrier which, in the opinion of the Engineer, is damaged by the traveling public to the extent it is no longer serviceable. Use traffic barrier from the designated stockpile site. The Contractor will be paid to remove and replace the traffic barrier damaged by the traveling public. Return damaged traffic barrier to the stockpile site located at the interchange of IH 20 and Little Road in Tarrant County.

Once project is complete remove traffic barrier and stockpile at site located at the interchange of IH 20 and Little Road in Tarrant County.

**Items 530 And 531. Intersections, Driveways and Turnouts, and Sidewalks**

The furnishing and installation of the sand cushion in proposed sidewalks, sidewalk ramps, and driveways will not be paid for directly but will be subsidiary to this bid item.

CONCRETE SIDEWALKS (SPECIAL) (TYPE A) shall be placed at locations adjacent to SSTR rail as shown in the plans and Detail CSWD-08 (FW)(MOD).

**Item 540. Metal Beam Guard Fence**

The locations and lengths of guard fence shown on the plans are approximate. Actual lengths and locations are to be determined in the field.

The tops of timber posts will be domed. Beveled tops will not be permitted for timber or steel posts.

When holes for timber posts are drilled below bottom of proposed grade, backfill the excessive depth with an acceptable sand. The furnishing and installation of the sand backfill will not be paid for directly but will be subsidiary to this Item.

When guardrail posts are placed in a finished surface, backfill the top 4 inches with an asphaltic material, domed to carry water away from the posts or as shown on the plans. The furnishing and installation of the asphaltic material backfill will not be paid for directly but will be subsidiary to this Item.

**Item 542. Removing Metal Beam Guard Fence**

Remove existing metal beam guard fence only when authorized.

**Item 556. Pipe Underdrains**

Install pipe underdrains at locations shown on the plans or as directed.

The unit price bid per linear foot of "pipe underdrain" shall include the cost of making connections to storm drain lines.

Furnish Type E filter material for this project conforming to the following gradation (Test TEX-200-F, Part 1):

Retained on Sq. Sieve	Percent by Weight
1/2 in.	0
3/8 in.	0 - 2
No. 4	40 - 85
No. 10	95 - 100

**Item 545. Crash Cushion Attenuators**

Remove salvageable units and stockpile at South Tarrant County Maintenance Yard at 2501 SW Loop 820, Fort Worth, Texas 76133.

**Item 618. Conduit**

Place conduit runs behind curbs at all locations where curbs exist.

Place conduit along the road a minimum clearance of six (6) feet from the back of curbs, unless such clearance shall interfere with "straight through" conduit placement, conflict with retaining walls or utilities, introduce additional or unnecessary right angle bends into the cable path, or the placement is restricted by the right of way. Adjust, with Engineer's approval, the placement of conduit and ground boxes to ensure the "straight through" conduit concept and avoid the aforementioned interference; conflict, or introduction of additional, unnecessary bends. Place conduit a minimum of 48 inches deep, unless otherwise approved by the Engineer.

All conduit elbows and rigid metal extensions required to be installed on PVC conduit systems will not be paid for separately, but will be considered subsidiary to various bid items.

High-density polyethylene (HDPE) pipe may be threaded and used with threaded PVC connectors or couplings.

PVC conduit systems that snap or lock together without glue that are designed and UL listed to be used for bored PVC electrical conduit applications will be allowed for bored PVC schedule 40 or schedule 80, when approved by the Engineer.

No additional compensation will be paid to the Contractor when these specific purpose conduit systems are substituted for this purpose.

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Place conduit under existing pavement at a minimum depth of four (4) feet below the pavement surface. Jack and bore all conduits placed under existing pavement at no additional expense to the State.

At location where the conduit cannot be placed at the required 48 inches depth, place a minimum of 6" wide x 4" thick miscellaneous concrete covering along the conduit run as directed by the Engineer. All work, materials, services involved to place the 4" thick concrete covering shall not be paid directly, but shall be considered subsidiary to Item 618.

Conduit entry to ground boxes Type "AS" shall be perpendicular to the perforated sidewall. Do not use 90 degree or right angle fittings to achieve perpendicular conduit alignment. Where approved by the Engineer, use 3 foot minimum long radius bends. Where conduit is placed by jacking or boring, adjust the conduit placement to accommodate perpendicular entry and long sweep bends.

Seal all conduits in the cabinets with expandable urethane foam.

Place cables in conduit to provide maximum use of each conduits capacity, as defined by the NEC. Each conduit shall be completely filled, according to NEC guidelines, before cables may be placed in another conduit; however, the Contractor is still responsible for mandated cable separations as directed by the Engineer (e.g. placing power cables in separate conduit from communications cables).

Backfill all open trench/excavation by dusk. Do not leave any open trench/excavation overnight.

The plans show the conduits numbered and specific cables in specific conduits. The purpose of these notes is to instruct the Contractor on how to group the cables in the conduits and not to specify the exact conduit that is to carry the cables i.e., the numbering system used is arbitrary and may be set by the Contractor with Engineer's approval.

Install a metallic underground warning tape for each ITS conduit run. This warning tape will be imprinted with "CAUTION BURIED FIBER OPTIC CABLE." The warning tape does not need to be installed when conduit is bored under a roadway section. This tape is subsidiary to this item.

After installing conduit and pulling conductor, leave a high tensile strength polyester fiber pull tape in the conduit for future use.

### **Item 620. Electrical Conductors**

Clearly and permanently mark each illumination conductor installed in a signal pole as "ILLUMINATION" where it can be clearly seen from the hand hole. Use plastic zip ties with labeling plate to mark conductor.

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**Item 628: Electrical Services**

Before installing any electrical service, consult with the appropriate utility company before beginning work and verify all metering equipment requirements with the provider have been met. **Provide a commercial grade, meter base with by-pass switch.**

TxDOT will make application to the Electric Utility Company for service. Contact the TxDOT Signal Shop to make arrangements.

The Contractor shall be responsible for the cost of electrical permit and the installation of the electric service.

The electric service shall be 100 amps with 120/240 voltage branch circuit and shall comply with City Standard Specifications and City Details as applicable per plans.

**Item 656. Foundations for Traffic Control Devices**

Stake foundations as shown on plans. Obtain Engineer's approval of location before installing foundation.

**Item 658. Delineators and Object Markers**

Only Recycled Rubber posts will be accepted on this project.

**Item 666. Reflectorized Pavement Markings with Retroreflective Requirements**

Collection of retroreflectivity readings using a mobile retroreflectometer is the preferred method. If retroreflectivity readings are collected using a portable or handheld unit, then measurement is defined as a collective average of at least 20 readings taken along a 200-foot test section. A minimum of three measurements will be required per mile of roadway. Measurements collected on a centerline stripe will be averaged separately for stripe in each direction of travel. A TxDOT inspector must witness the calibration and collection of all retro-reflectivity data.

**Item 680. Installation of Highway Traffic Signals**

Furnish and install all required materials, incidentals and equipment necessary for a fully operational traffic signal. The proposed equipment shall be compatible with the existing systems in the area.

Furnish and install a 350i ATC cabinet and 2070 controller subsidiary to Item 680

Provide all illumination fixtures to be installed in this contract. Use 250W equivalent LED luminaires.

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Where work requires the removal of power from the controller and cabinet assembly, erect temporary stop signs. Remove the stop signs after the traffic signals are in operation.

Deliver the cabinet, controller, accessories, and three complete sets of signal construction plans to the TxDOT Signal Shop, 2501 SW Loop 820 at McCart Street, Fort Worth for testing. Notify the Signal Shop two working days prior to delivery of the cabinet.

Wire the signal installation to operate in accordance with phase diagrams in these plans. Timing and phasing will be maintained by the operating agency. Deliver a copy of all revisions to the original timing and phasing plans to the TxDOT Signal Shop. One copy is to stay in the controller cabinet at the completion of the project.

**Project Inspection.** Contact the TxDOT Signal Shop in advance of needed inspections. At the time of the final electrical inspection, the Inspector will create a discrepancy list to be corrected and repaired before signal is put into flash mode.

**Signal Flash.** Upon the satisfactory completion of repairs or corrections, contact the TxDOT Signal Shop at least one week prior to placing in flash. Schedule signal flash for Monday thru Thursday between 9:00 AM – 12:00 PM. Operate the signal in flash mode for 2-3 days prior to turning on to full actuation. The TxDOT signal inspector and technician must be present when the signals are placed in flash.

**Signal Turn-On.** Upon completion of the signal flash, schedule the date and time for the turn on of the traffic signal on Monday thru Thursday between 9:00 AM – 12:00 PM. Place the traffic signal into full operation only after all required striping is complete and all conflicting signing is removed. The TxDOT signal inspector and technician must be present when the signals are placed in full color operation.

**Test Period.** During the 30-day test period, the TxDOT Signal Shop will be the first responders to all trouble calls. They will, in turn contact the Contractor. Provide qualified personnel to respond to these and all trouble calls. Provide a local telephone number, not subject to frequent changes and available to receive calls on a 24-hour basis. Respond to reported calls within a maximum of two hours. Make appropriate repairs within 24 hours.

Place a logbook in each controller cabinet and keep a record of each trouble call reported. Notify the Engineer of each trouble call. The error log in the conflict monitor shall not be cleared during the thirty-day test period without approval. If it is necessary to replace equipment, such as a controller, in order to return the signals to normal operation, TxDOT will provide temporary replacement equipment until the original equipment is repaired and then replaced.

**Removal.** Remove stop signs prior to signal turn-on. Stop Signs shall remain the property of TxDOT. Deliver to the TxDOT Signal Shop.

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**Item 682: Vehicle and Pedestrian Signal Heads**

Vehicle signal heads shall be yellow aluminum with 5 inch, black, aluminum, vented back plates unless otherwise shown on plans.

Signal heads shall be installed level and plumb and aimed as directed. Cover all signal faces until placed in operation.

All signal heads shall be McCain™, Econolite™, or approved equivalent style and dimensions.

All LED signal indications shall be General Electric (GE) Gelcore™ and meet the latest ITE standards.

All LED signals shall be of the incandescent appearance.

**Item 684. Traffic Signal Cables**

Clearly and permanently mark each cable as shown on the plans (CABLE 1, etc.) at each signal head, ground box, terminal block, pole base and controller. Use plastic zip ties with labeling plate to mark cable.

Provide an extra 10' for each cable terminating in the controller cabinet.

Terminate all electrical conductors from the controller (including spares) at the termination block in the signal pole hand hole.

**Item 686. Traffic Signal Pole Assemblies (Steel)**

Provide all signal poles for a project or work order from the same manufacturer.

Install mast arm damping plates at the end of SMA and DMA standard poles in accordance with the details shown in the MA-DPD standard sheet. Dampers for LMA poles may be required as directed by the Engineer.

Plug any unused openings in the mast arms or poles with an approved material.

Provide a 3-piece bracket assembly on strain poles or drill the pole and use thimble eyebolts to attach the strand vise for the span wire.

**Item 688. Pedestrian Detectors and Vehicle Loop Detectors**

For Accessible Pedestrian Signals. Provide a completed final system operational check list, completed schematic diagram for pushbutton station locations, and a completed default and field

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settings sheet as provided in the APS manufacturer's manual. Provide a factory certified representative for testing and set up of the equipment at the time of signal flash and turn on.

**Item SS6022. 2070 ATC Controller**

Furnish and install a 2070 ATC controller subsidiary to Item 680.

**Item SS6083. Iteris Vantage Vector**

Mount detector as shown in plans or as directed by the engineer. Adjust heights and locations of sensors to achieve the best possible detection.

Contact the TxDOT Signal Shop for assistance with set up. Provide a factory certified representative for testing and set up of the equipment at the time of signal flash and turn on.

**Item 6001. Portable Changeable Message Signs**

Provide all portable changeable message signs and arrow panels with a photoelectric device to allow for automatic dimming of operations to approximately 50% of their normal brightness when ambient light drops to approximately five footcandles, and then increase back again for daytime operations.

(2) electronic portable changeable message sign unit(s) will be required. Individual or collective use of signs will be required by the Engineer when deemed necessary to supplement the traffic control plan.

If more than one (1) crew works on the same day, but in different locations, each crew will use portable changeable message signs and arrow panels.

Each sign must have programmed in its permanent memory the following 18 messages:

1. Exit Closed Ahead
2. Use Other Routes
3. Right Lane
4. Left Lane
5. Closed Ahead
6. Two Lane
7. Detour Ahead
8. Thru Traffic
9. Prepared To Stop
10. Merging Traffic
11. Expect 15 Minute Delay
12. Max Speed \*\* MPH

13. Merge Right
14. Merge Left
15. No Exit Next \*\* Miles
16. Various Lanes Closed
17. Two Left Lanes Closed
18. Two Right Lanes Closed

**General Notes – Intelligent Transportation Systems (ITS)**

For the following category of ITS work, the contractor should use those subcontractors that are prequalified to do that category of work. The category of work and the contractors prequalified for that type of work are shown below.

**Closed Circuit Television (CCTV) Equipment Installation:**

A&G Eberhardt Enterprises, Inc.  
A.G. Hill Power, Inc.  
Alcatel Contracting Inc.  
Austin Traffic Signal Const. Co  
Broadband Systems Integration  
Cable Constructors, Inc  
Church & Tower Fiber Tel  
COMSAT RSI  
Designed Telecommunications, Inc.  
Durable Specialties, Inc.  
EAS Contracting, LP  
F & W Electrical Contractors, Inc.  
Florida Traffic Control Devices Inc.  
G.U.Y. Construction, LLC  
Georgia Electric Company  
Grady Crawford Construction, Inc.  
H.B. Zachry Company  
Highway Intelligent Traffic Solution  
Highway Intelligent Traffic Systems  
Hy Power, Inc.  
InfraSource, Inc.  
Integrated Roadway Services, Inc.  
Integrated Telecommunications, Inc.  
J&V Communication Services, Inc.  
Mass Electric Construction Co.  
MasTec North America, Inc.  
Mica Corporation  
Pfeiffer & Son, Inc.

Power Engineers, Inc.  
Republic ITS  
Star Operations, Incorporated  
Statewide Traffic Signal Company  
The Levy Company, L.P.  
Third Coast Services LLC  
Traffic Systems Construction, Inc.  
Traf-Tex, Inc.  
Trans Tech Electric, Inc.  
TransCore ITS, LLC  
Tri-State Electric, Ltd  
Vadco Electric, Inc.  
Viasys Services, Inc.  
World Fiber Technologies, INC.

The prime contractor should choose from the above contractors that are already prequalified for that type of work. The prime contractor may choose another subcontractor that is not on this list. However, the Engineer may reject the subcontractor if the contractor cannot show that the proposed subcontractor meets similar requirements for prequalification in the above listed categories.

The contractor should contact the Engineer of Traffic at (512)416-3118 for details on the requirements for prequalification.

The major components of the ITS system consist of the installation of conduit, Closed Circuit Television CCTV, Radar Vehicle Sensing Device (RVSD), Wireless Communications, Ethernet Switch, and Serial Server Unit.

Furnish and install all incidental work, material and services not explicitly called for in the specifications or not shown in the plans, which may be necessary for a complete and properly functioning ITS system.

Do not submit submittals for devices identified as end-of-life by the manufacturer.

Perform all work in this project in a manner acceptable to and approved by the Engineer.

Contact Texas excavation safety system at 1-800-dig-tess or 1-800-344-8377, and TxDOT Traffic Operations group at 817-370-3664 prior to beginning any excavation work in the area of existing utilities, to prevent any damage or interference with present facilities.

The quantities provided in the sheet summary tables and general notes are estimates to be used for Contractor information only and may not reflect the actual quantities required to accomplish this project.

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Deliver all cabinets to be furnished and installed in this project to TxDOT Fort Worth District Headquarters located at 2501 Southwest Loop 820, Fort Worth, Texas, 76133, for specification compliance testings by the Traffic Management personnel before any cabinet is installed.

Correct and re-test cabinet(s) failing to comply with the specifications prior to being released for transportation to and installation in the field. Transport the cabinet(s) to the field for installation after successfully completing the testing.

No payment shall be made directly for the transportation of the cabinet(s) to and from the District for testing or other incidentals required to complete the work. This work shall be considered subsidiary to the various types of cabinet(s) called for in the project.

Do not supply software which requires software keys, hardware locks, or any other external or internal security device mechanism or contrivance to properly perform the full intended, advertised and/or required system function for which the software is supplied or is being purchased. Security codes and/or distribution media serial numbers required by the software's installation and/or setup routine's are acceptable and are specifically exempted from the above prohibition.

Verify the location of all existing underground installations and provide adequate protection for them. Replace all existing underground installations damaged by Contractor's forces during construction at no cost to the state.

Contact the utility companies or the utility coordinating committee for exact locations prior to drilling for foundations or any other work that might interfere with or damage present facilities. Contact the appropriate utility company prior to making any adjustments. Repair any damage to existing water mains, gas lines, etc., at no cost to the state or the city. Verify all existing water mains and other underground utilities and contact the respective utility company 48 hours prior to excavating. Coordinate with the respective utility company for any adjustment necessary to the utility at no cost to the Department.

Procure all permits and licenses.

Permit the electrical work to be inspected by the State.

The Engineer shall approve the starting date for system acceptance testing and, if required, shall terminate the system testing because of malfunctions or obvious unsuitability of the equipment.

Do not remove or relocate existing equipment in existing cabinets without the Engineer's approval.

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Install all necessary shelves, terminal panels, wiring, cabling, harnesses, etc. where new equipment is to be installed in existing cabinets. All costs associated with these cabinet modifications shall be considered subsidiary to the various bid items.

The locations of all ground boxes, foundations, and structures shall be as shown on the plans and may be moved only as approved by the Engineer in writing.

Remove any obstructions to existing drainage due to the contractor's operation as required at the Contractor's entire expense.

Replace all pavement, shoulders and metal beam guard fence damaged by Contractor's forces during construction at no cost to the state.

Ensure existing curb, and curb and gutter is not discolored or damaged during construction operations. In the event of discoloration or damage, clean or repair as directed.

**Item 416. Drilled Shaft Foundations**

Stake foundation locations and have them approved by the inspector before installation. Notify the Inspector 48 hours prior to forming and placing concrete. Do not place concrete without an Inspector present. Failure to inform the Inspector and provide adequate time to arrive on the job site may result in removing and replacing the foundation.

**Item 432. Riprap**

If the Contractor is required to place conduit under existing riprap, remove and replace riprap according to Item 432, "Riprap", except for measurement and payment. Replace riprap to a depth and finish matching that of the original riprap. Measurement and payment for riprap shall be subsidiary to Item 618 and no additional payment shall be made for this work.

**Item 618. Conduit**

Place conduit runs behind curbs at all locations where curbs exist.

Place conduit along the frontage road a minimum clearance of six (6) feet from the back of curbs, unless such clearance shall interfere with "straight through" conduit placement, conflict with retaining walls or utilities, or introduce additional or unnecessary right angle bends into the cable path. Adjust, with Engineer's approval, the placement of conduit and ground boxes to ensure the "straight through" conduit concept and avoid the aforementioned interference; conflict, or introduction of additional, unnecessary bends. Place conduit a minimum of 48 inches deep, unless otherwise approved by the Engineer.

Install a continuous bare or green insulated copper wire no. 8 AWG or larger in every conduit throughout the electrical system in accordance with the electrical detail sheets, and the latest edition of the National Electrical Code.

For power carrying conduit, provide a continuous grounded system. If PVC or HDPEC is used, the continuous system shall be accomplished by running 1-#8 bare copper wire in conduit between foundations and grounding it at each foundation ground rod. If rigid metal conduit is used, it shall be bonded to form a continuous system.

All conduit elbows and rigid metal extensions required to be installed on PVC conduit systems will not be paid for separately, but will be considered subsidiary to various bid items.

High-density polyethylene (HDPE) pipe may be threaded and used with threaded PVC connectors or couplings.

PVC conduit systems that snap or lock together without glue that are designed and UL listed to be used for bored PVC electrical conduit applications will be allowed for bored PVC schedule 40 or schedule 80, when approved by the Engineer.

No additional compensation will be paid to the Contractor when these specific purpose conduit systems are substituted for this purpose.

Place conduit under existing pavement at a minimum depth of four (4) feet below the pavement surface. Jack and bore all conduits placed under existing pavement at no additional expense to the State.

At location where the conduit cannot be placed at the required 48 inches depth, place a minimum of 6" wide x 4" thick miscellaneous concrete covering along the conduit run as directed by the Engineer. All work, materials, services involved to place the 4" thick concrete covering shall not be paid directly, but shall be considered subsidiary to Item 618.

Conduit entry to all ground boxes shall be perpendicular to the perforated sidewall. Do not use 90 degree or right angle fittings to achieve perpendicular conduit alignment. Where approved by the Engineer, use 3 foot minimum long radius bends. Where conduit is placed by jacking or boring, adjust the conduit placement to accommodate perpendicular entry and long sweep bends.

Seal all conduits in the cabinets with expandable urethane foam.

Place cables in conduit to provide maximum use of each conduits capacity, as defined by the NEC. Each conduit shall be completely filled, according to NEC guidelines, before cables may be placed in another conduit; however, the Contractor is still responsible for mandated cable separations as directed by the Engineer (e.g. placing power cables in separate conduit from communications cables).

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Backfill all open trench/excavation by dusk. Do not leave any open trench/excavation overnight.

The plans show the conduits numbered and specific cables in specific conduits. The purpose of these notes is to instruct the Contractor on how to group the cables in the conduits and not to specify the exact conduit that is to carry the cables i.e., the numbering system used is arbitrary and may be set by the Contractor with Engineer's approval.

### **Item 620. Electrical Conductors**

Do not use non-certified persons to perform electrical work. Electrical certification for this project will be as per Item 7 of the current Texas Standard Specifications and any Special Provisions to Item 7.

All cable ties shall be securely fastened by rivet or other mechanical means. Do not use double-sided adhesive stick-ons or pressure clamps.

Include extra cable length in each run to provide adequate slack at each ground box or cabinet, as determined by the Engineer.

Furnish and attach compression type connectors with a compression mechanical release hand crimping tool to each individual conductor before making connections to all terminal strips.

All electrical work shall be in conformance with latest edition of the National Electrical Code (NEC), and TxDOT Standards.

Bonding conductors no. 6 and smaller, tied to ground rods, shall be solid. Connection of bonding conductor to ground rod shall be made using UL listed connectors designed for such purpose.

All power conductors, shielded twisted wire pair cables, coax cables, control cables and fiber optic cables shall be color-coded consistently or permanently labeled between all connections and splices to ensure immediate identification. Submit a chart or list identifying all cables and conductors in a logical and sequential manner prior to installation for the Engineer's approval.

All conductors shall be continuous without splices from terminal point to terminal point or otherwise as directed by the Engineer.

When pulling cables, conductors or innerducts through conduit, lubricate the cables, conductors or innerducts with a lubricant generally used for this purpose. The lubricant shall be non-aqueous, non-toxic and non-conductive and shall not harm the conduit or the insulation of cable.

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Test each wire of each cable or conductor before and after installation. Any incomplete circuit or damage to any wire or cable will be cause for immediate rejection of the entire cable being tested. Remove and replace the rejected cable at Contractor's own expense.

Bond the grounding conductors that share the same conduit, junction box, ground box or structure together at every accessible point in accordance with the electrical detail sheets, and the latest edition of the National Electrical Code, and as per TxDOT Standards.

All circuits shall test clear of faults, grounds and open circuits.

Use ratchet type crimp tools to install connectors and terminations on all type of cables.

### **Item 628. Electrical Services**

Locations of service poles as shown on the layouts are approximate. Contact the electric utility provider for electric service and for exact locations. Locations of the service poles are subject to approval by the Engineer. The service pole for each location shall supply 120/240v/ 3 wire single phase circuit.

The street address of the electrical service and "Surveillance" will be stenciled in one inch high black letters on the meter side of the enclosure.

Do not apply power to service poles until approved by the Engineer. Verify all power locations. Place a decal stating "Danger/High Voltage" on the cover of the enclosure above the street address of the electrical service and surveillance lettering. The size of the decal and lettering shall be as approved by the Engineer.

No photo-electric control, lighting contactor and control unit- "manual-off-automatic" shall be needed in the service pole.

Before installing any electrical service, verify all metering equipment requirements with the electric service provider. The Contractor shall provide a commercial grade, meter base with by-pass switch as part of this item when required by the electric provider.

All work and incidentals performed, as described, shall not be paid for directly but shall be considered subsidiary to Item 628.

### **Item 6005. Testing, Training, Documentation, Final Acceptance and Warranty.**

It is the policy of the Department to require performance testing of all materials and equipment not previously tested and approved. If technical data is not considered adequate for approval, samples may be requested for test by the Engineer. The contract period will not be extended for time lost or delays caused by testing prior to final Department approval of any items.

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Four (4) complete sets of operation and maintenance manuals shall be provided prior to the installation of the equipment. Schematics shall be updated at the end of the job to show "as-built" condition.

**Item 6010. Closed Circuit (CCTV) Field Equipment**

This item shall also include, but is not limited to, the following subsidiary items:

- Connecting harnesses of appropriate length and terminated with matching connectors for interconnection with communications system equipment
- Video and camera control cable harnesses, connectors, camera filters, control circuits, and accessories
- 60 LF of CCTV multi-conductor cable

No payment shall be made directly for the subsidiary items furnished and installed, or other incidentals required to complete the work, but shall be considered subsidiary to this Item.

**Item 6029. Radar Vehicle Sensing Device (RVSD)**

This item shall also include, but is not limited to, the following subsidiary items:

- Connecting harnesses of appropriate length and terminated with matching connectors for interconnection with communications system equipment
- 40 LF of radar detection cable(s) (regardless of number of cables required)

No payment shall be made directly for all the above mentioned work and for the subsidiary items furnished and installed, or other incidentals required to complete the work, but shall be considered subsidiary to this Item.

Ensure the RVSD provides accurate, real-time volume, average speed, occupancy, and vehicle direction data. Ensure the RVSD provides user configurable settings for a collection interval from 20 sec. to 15 min. and polling intervals from 20 sec. to 1 hr. Ensure the detections are correctly categorized into a minimum of 8 user definable length-based classifications. Ensure vehicle detections occur at a range of 9 ft. to 250 ft. simultaneously from the RVSD. Ensure the RVSD unit or accompanying field equipment provides a minimum of 3 hr. of local storage for detection interval settings of 20 sec. to 15 min. in local storage to reduce data loss during communications outages. Ensure the RVSD transfers locally stored data to the Traffic Management Center's™ Transportation Sensor System (TSS) when communication is restored.

Ensure per vehicle speed data is accurate within 5 mph for 90% of measurements. Provide true speed detection via dual radar speed trap without the requirement to enter average vehicle lengths for the speed calculation.

Ensure the RVSD automatically configures vehicle direction and that vehicle direction is accurately determined for 90% of wrong-way vehicles. This data shall be available simultaneously and in addition to other data as called for in this specification.

**Item 6062. Intelligent Transportation System (ITS) Radio**

This item shall also include, but is not limited to, the following subsidiary items:

- Connecting harnesses of appropriate length and terminated with matching connectors for interconnection with communication s system equipment
- 120 LF of power/signal cable(s) (regardless of number of cables required)

No payment shall be made directly for all the above mentioned work and for the subsidiary items furnished and installed, or other incidentals required to complete the work, but shall be considered subsidiary to this Item.

**Item 6186. Intelligent Transportation System (ITS) Ground Box**

The Department requires all ground boxes be properly drained. If the engineer determines a ground box is not properly drained because it is placed to match the slope of the existing grade, reconstruct and/or relocate the drain hole and cushion (washed gravel or crushed stones), as required, to ensure efficient evacuation of fluids from the ground. The contractor is advised, therefore, to make any adjustments required for efficient drainage prior to initial placement, to avoid any necessary re-work.

The existing ground boxes are welded shut, buried, or sealed with a concrete pad. The Contractor shall be responsible for access to the existing ground boxes and restoring to original photographically documented conditions (by the Contractor); this includes any removals necessary to access the ground box as well as concrete, welding, repairing galvanized welded areas in accordance with Item 445 “Galvanizing,” etc. to establish ground box lid to original conditions after fiber or conductors work is complete. The Contractor is responsible for the security of both new and existing ground boxes and ground boxes contents such as wiring, fiber optic cables, splice closures, etc. while they are uncovered or not welded. New ground boxes will be sealed by tack welding two corners for at least two inches on each side after work is completed.

No payment shall be made directly for all the above mentioned work, or other incidentals required to complete the work, but shall be considered subsidiary to this Item.

Class “A” concrete design shall be a Fort Worth District concrete approved design.

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### **Miscellaneous**

TxDOT personnel will verify network communications to the work site from an appropriate satellite building or from TransVision. If network communications fail, the Contractor will correct the fault so that successful communication is established. The Contractor will correct all problems related to his work which develop during the test at no additional cost to the state.

Reference to any specific manufacturer's name, make or number for any item of equipment or material necessary to meet the requirements of the specifications and the plans is intended to be descriptive but not mandatory and is intended to indicate the type of equipment or materials that will be acceptable. The type of equipment or materials that will be acceptable shall be subject to acceptable test results, by the Engineer or his named representative, at the time of product installation. However, provide all like items on this contract to be identical and from the same manufacturer.

Within thirty days after the authorization to begin work, provide four copies of descriptive manuals and brochures for each type of electronic equipment and apparatus proposed for this project. These documents shall contain sufficient technical data for complete evaluation. Incomplete submittals will not be accepted. Describe the quality, function and capability of each deliverable item. Submit originals or copies equal in quality to the originals manuals or brochures. Where a brochure describes several similar items, highlight the specific item being submitted. Where an item has several options or accessories, highlight the options or accessories he intends to deliver. Bond all manuals, brochures, and data sheets relating to a bid item together in a folder. Identify on the cover with the TxDOT contract number, title and bid item number. Submit four copies of detailed equipment submittals and shop drawings for each fabricated item proposed for this project within thirty days after the authorization to begin work. Submit these equipment submittals and drawings to contain all information required for complete evaluation and fabrication in accordance with the plans and specifications. Submit shop drawings on sheets that are 22 inches in height and 34 inches long sheet shop drawings. Drawings may be prepared on half- scale sheets or full size drawings may be reduced to half-scale size, if they are completely clear and legible. Stamp the drawings with Contractor's approval, sequentially numbered and identified as to TxDOT contract number, title and bid item number.

The Engineer, upon approval of the above submittals, will indicate any correction to the details in the submittals.

Correct any errors in the submittals, as directed by the Engineer, and if required, shall resubmit to the Engineer four copies of the same. Begin work upon approval of the corrected drawings and equipment. No change will be permitted in the list of equipment or shop drawings once approved, unless authorized by the Engineer in writing.

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Equipment will not be accepted for delivery or any payment made until the equipment, materials lists and shop drawings have been approved by the Engineer. Approval by the Engineer does not relieve the Contractor of his responsibilities to meet the requirements of the specifications and plans.

The TxDOT, through its authorized representative, retains the right to inspect all structures, equipment and materials used in the project before, during and after installation, also the right to inspect the work during the process of fabrication or manufacture for the purpose of determining if the plans and specifications upon which the award was made are being complied with and being satisfied as to quality of the material and workmanship. Such inspection will not release the manufacturer from strict compliance with specifications when the work is finally completed and offered for acceptance.

Provide each field cabinet with three copies of the final as-built cabinet wiring diagrams. Deliver a mylar reproducible of the cabinet wiring diagrams showing all field changes incorporated by the Contractor to the Engineer.

Provide system support during the entire project. This includes any required design reviews, complete "parts and labor" on-site maintenance until final acceptance by the state, operational support during system integration and manufacturer's warranties and guarantees at no additional cost to the state.

Conduct design reviews of the entire ITS system as required, at no additional cost to the State. The Contractor is responsible for all new materials and equipment furnished and installed, as well as existing equipment modified as part of this contract, until final acceptance of the system. The Contractor is responsible for the replacement of equipment that fails due to all causes including theft, vandalism and "knock downs".

Designate an ITS supervisor who shall be responsible for the ITS project and serve as the Contractor's official contact with the Department. This ITS supervisor shall be on-site from the beginning of the ITS construction until final system acceptance. Supplement the ITS supervisor's support with the services of qualified Engineers and the services of vendor technical representatives for the duration of the project.

Upon final system acceptance, furnish a set of as-built plans which shall show the actual equipment installation and construction details.

Provide complete on-site parts and labor support for the furnishing and the installation of the Traffic Management System for the duration of the entire project and during the warranty period. During the project, make any adjustments or repairs which may be required and correct any defects or damages that may occur at Contractor expense.

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During the warranty period, furnish parts and labor required to repair, on-site, any manufacturer's defects (materials or workmanship), damage caused by manufacturer's defects and damage caused by the Contractor during the performance of warranty work. Natural disasters or other events not directly controllable by the Contractor are specifically exempted from warranty.

During the test period, make any adjustments or repairs which may be required and remedy any defects or damages that may occur at Contractor expense.

No time charges will be assessed during the 90 days test period, provided all other work is completed to the satisfaction of the Engineer.

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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 (100)  
ITEM 104 REMOVING CONCRETE  
ITEM 110 EXCAVATION (132)  
ITEM 132 EMBANKMENT (100) (160) (204) (210) (216) (260) (400)  
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 260 LIME TREATMENT (ROAD-MIXED) (105) (132) (204) (210) (216)  
(247) (300) (310) (520)  
ITEM 275 CEMENT TREATMENT (ROAD-MIXED) (132) (204) (210) (216) (247)  
(300) (310) (520)  
ITEM 305 SALVAGING, HAULING, AND STOCKPILING RECLAIMABLE ASPHALT  
PAVEMENT  
ITEM 310 PRIME COAT (300) (316)  
ITEM 341 DENSE-GRADED HOT-MIX ASPHALT (300) (301) (320) (520) (585)  
ITEM 360 CONCRETE PAVEMENT (421) (422) (438) (440) (529) (585)  
ITEM 400 EXCAVATION AND BACKFILL FOR STRUCTURES (110) (132) (401)  
(402) (403) (416) (420) (421) (423)  
ITEM 402 TRENCH EXCAVATION PROTECTION  
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 422 CONCRETE SUPERSTRUCTURES (420) (421) (424) (438) (440) (448)  
(454) (780)  
ITEM 423 RETAINING WALLS (110) (132) (216) (400) (416) (420) (421) (424)  
(440) (445)

ITEM 425 PRECAST PRESTRESSED CONCRETE STRUCTURAL MEMBERS (409)  
 (420) (421) (424) (426) (427) (434) (440) (442) (445)  
 ITEM 432 RIPRAP (247) (420) (421) (431) (440)  
 ITEM 442 METAL FOR STRUCTURES (441) (445) (446) (447) (448)  
 ITEM 450 RAILING (420) (421) (422) (424) (440) (441) (442) (445) (446)  
 (448)  
 ITEM 454 BRIDGE EXPANSION JOINTS (429) (442) (785)  
 ITEM 462 CONCRETE BOX CULVERTS AND DRAINS (400) (402) (403) (420)  
 (421) (422) (424) (440) (464) (476)  
 ITEM 464 REINFORCED CONCRETE PIPE (400) (402) (403) (467) (476)  
 ITEM 465 JUNCTION BOXES, MANHOLES, AND INLETS (400) (420) (421) (424)  
 (440) (476)  
 ITEM 466 HEADWALLS AND WINGWALLS (400) (420) (421) (432) (440) (464)  
 ITEM 467 SAFETY END TREATMENT (400) (420) (421) (432) (440) (442) (445)  
 (460) (464)  
 ITEM 479 ADJUSTING MANHOLES AND INLETS (400) (421) (465) (471)  
 ITEM 496 REMOVING STRUCTURES  
 ITEM 500 MOBILIZATION  
 ITEM 502 BARRICADES, SIGNS, AND TRAFFIC HANDLING  
 ITEM 506 TEMPORARY EROSION, SEDIMENTATION, AND ENVIRONMENTAL  
 CONTROLS (161) (432) (556)  
 ITEM 508 CONSTRUCTING DETOURS  
 ITEM 512 PORTABLE CONCRETE TRAFFIC BARRIER (420) (421) (424) (440)  
 (442)  
 ITEM 529 CONCRETE CURB, GUTTER, AND COMBINED CURB AND GUTTER (360)  
 (420) (421) (440)  
 ITEM 530 INTERSECTIONS, DRIVEWAYS, AND TURNOUTS (247) (260) (263)  
 (275) (276) (292) (316) (330) (334) (340) (360) (421) (440)  
 ITEM 531 SIDEWALKS (104) (360) (420) (421) (440) (530)  
 ITEM 536 CONCRETE MEDIANS AND DIRECTIONIONAL ISLANDS (420) (421)  
 (427) (440) (529)  
 ITEM 540 METAL BEAM GUARD FENCE (421) (441) (445) (529)  
 ITEM 542 REMOVING METAL BEAM GUARD FENCE  
 ITEM 543 CABLE BARRIER SYSTEM (421) (658)  
 ITEM 544 GUARDRAIL END TREATMENTS  
 ITEM 545 CRASH CUSHION ATTENUATORS (421)  
 ITEM 556 PIPE UNDERDRAINS (402) (432)  
 ITEM 618 CONDUIT (400) (476)  
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 ITEM 621 TRAY CABLE (620)  
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 ITEM 636 SIGNS (643)  
 ITEM 644 SMALL ROADSIDE SIGN ASSEMBLIES (421) (440) (441) (442) (445)  
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 ITEM 647 LARGE ROADSIDE SIGN SUPPORTS AND ASSEMBLIES (416) (421)  
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 ITEM 666 RETROREFLECTORIZED PAVEMENT MARKINGS (316) (502) (662) (677)  
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ITEM 677 ELIMINATING EXISTING PAVEMENT MARKINGS AND MARKERS (300)  
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ITEM 680 HIGHWAY TRAFFIC SIGNALS (416) (610) (618) (620) (624) (625)  
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ITEM 682 VEHICLE AND PEDESTRIAN SIGNAL HEADS  
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ITEM 688 PEDESTRIAN DETECTORS AND VEHICLE LOOP DETECTORS (618)  
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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, MAY, 2012)

WAGE RATES

SPECIAL PROVISION "SCHEDULE OF LIQUIDATED DAMAGES" (000---001)  
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" (000---004)  
SPECIAL PROVISION "STANDARD FEDERAL EQUAL EMPLOYMENT OPPORTUNITY  
CONSTRUCTION CONTRACT SPECIFICATIONS" (000---005)  
SPECIAL PROVISION "ON-THE-JOB TRAINING PROGRAM" (000---006)  
SPECIAL PROVISION "DISADVANTAGED BUSINESS ENTERPRISE IN FEDERAL AID  
CONTRACTS" (000---007)  
SPECIAL PROVISION "IMPORTANT NOTICE TO CONTRACTORS" (000---010)  
SPECIAL PROVISION "CARGO PREFERENCE ACT REQUIREMENTS IN FEDERAL AID  
CONTRACTS" (000---241)  
SPECIAL PROVISION "CERTIFICATE OF INTERESTED PARTIES (FORM 1295)"  
(000---249)  
SPECIAL PROVISION "IMPORTANT NOTICE TO CONTRACTORS" (000---329)  
SPECIAL PROVISION TO ITEM 2 (002---004)  
SPECIAL PROVISION TO ITEM 6 (006---001)  
SPECIAL PROVISIONS TO ITEM 7 (007---001) (007---003) (007---004)  
SPECIAL PROVISION TO ITEM 300 (300---009)  
SPECIAL PROVISION TO ITEM 421 (421---002)  
SPECIAL PROVISION TO ITEM 506 (506---002)  
SPECIAL PROVISION TO SPECIAL SPECIFICATION ITEM 7021 (7021--001)

SPECIAL SPECIFICATIONS:  
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ITEM 6001 PORTABLE CHANGEABLE MESSAGE SIGN  
ITEM 6010 CCTV FIELD EQUIPMENT  
ITEM 6016 MULTI-DUCT CONDUIT SYSTEM  
ITEM 6029 RADAR VEHICLE SENSING DEVICE (RVSD)

ITEM 6062 INTELLIGENT TRANSPORTATION SYSTEM (ITS) RADIO  
ITEM 6064 INTELLIGENT TRANSPORTATION SY STEM (ITS) POLE WITH CABINET  
ITEM 6083 VIDEO IMAGING AND RADAR VEHICLE DETECTION SYSTEM  
ITEM 6186 INTELLIGENT TRANSPORTATION SYSTEM(ITS) GROUND BOX  
ITEM 7012 CURB INLET SEDIMENT CONTROL DEVICE  
ITEM 7021 WATER MAIN AND SEWER LINE REPLACEMENTS

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 SPECIFI-  
CATIONS FOR THIS PROJECT.

# 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  $\pm$  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 CoVu, 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  $\pm$  20%, 60 Hz  $\pm$  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  $\pm$  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, or most current version, for IP 66 or greater rating when providing a pressurized unit.
- Provide equipment that conforms to IEC 60529 Section 14.2.7, or most 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.

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### 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.

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#### 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.

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#### 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 -30°F to 122°F 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 -60°F to 200°F 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 (11-1/4°, 22-1/2°, 30°, 45°, and 90° 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 90° turn. Do not place markers in any roadway paved surface.

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## 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 or 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 relieve 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 Class B 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 coordinates,
  - pre-installation test procedures,
  - post-installation test procedures, and
  - as-built of installed conduit system.

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## 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.

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## 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 6029

## Radar Vehicle Sensing Device



### 1. DESCRIPTION

Furnish and install overhead radar vehicle sensing device (RVSD) system as shown in the plans, as detailed in the special specifications and as directed.

Ensure after the setup, there are no external tuning controls of any kind, which will require an operator.

### 2. MATERIALS

Ensure the RVSD will automatically configure the maximum number of lanes shown on the plans by determining lane boundaries, concrete or metal barriers and detection thresholds. Ensure sensor will automatically configure the number of lanes in the presence of barriers, medians and work zones. Ensure sensor will automatically calibrate vehicle speed, detection levels, and sensitivity. Ensure the RVSD detects vehicle volume, speed and occupancy in all weather conditions without performance degradation. Ensure the RVSD is remote accessible; provides multiple connectivity options for integration into the existing system, and supports the communications protocols identified in Section 2.D "Communication."

Provide the RVSD that automatically tunes out stationary objects, such as traffic barriers and retaining walls, prior to completing the configuration. Provide documentation on the auto-configuration and auto-calibration processes.

Provide an RVSD that does not cause interference or alter the performance of any known equipment.

Furnish all new equipment and component parts in an operable condition at the time of delivery and installation.

Provide design to prevent reversed assembly or improper installation of connectors, fasteners, etc. Design each item of equipment to protect personnel from exposure to high voltage during equipment operation, adjustments, and maintenance.

Include licenses for all equipment, where required, for any software or hardware in the RVSD system.

Provide all RVSD from the same manufacturer.

Provide RVSD firmware that is upgradeable by external local or remote download.

- 2.1. **Sensor Performance.** Ensure the RVSD provides accurate, real-time volume, average speed and occupancy data. Ensure the RVSD provides user configurable settings for a collection interval from 20 sec. to 15 min. and polling intervals from 20 sec. to 1 hr. Ensure the detections are correctly categorized into a minimum of 3 user definable length-based classifications. Ensure vehicle detections occur at a range of 9 ft. to 200 ft. from the RVSD. Ensure the RVSD unit or accompanying field equipment provides a minimum of 3 hours of local storage for detection interval settings of 20 seconds to 15 minutes in local storage to reduce data loss during communications outages. Ensure the RVSD transfers locally stored data to the Traffic Management Center's Transportation Sensor System (TSS) when communication is restored.

Transportation Sensor System (TSS) Protocol Document (TSS-Protocol) is available through the "TSS Tools" link on the Department's website,  
URL: [http://www.dot.state.tx.us/services/information\\_systems/engineering\\_software.htm](http://www.dot.state.tx.us/services/information_systems/engineering_software.htm)

Ensure the RVSD operates in side-fire mode. When operating in side-fire mode, a single RVSD must simultaneously detect traffic in the maximum number of lanes as shown on the plans.

Ensure the RVSD maintains accurate performance in all weather conditions, including rain, freezing rain, snow, wind, dust, fog and changes in temperature and light. Ensure RVSD operation continues in rain or snow up to 4 in. per hour, and the device will not experience degraded performance when encased in 1/2 in. of ice.

Ensure volume data is accurate within 5% of actual for any direction of travel in nominal conditions. Ensure individual lane accuracy is within 10% of actual during nominal conditions. Nominal conditions exist when traffic is flowing at speeds greater than 10 miles per hour, with less than 10% truck traffic per lane and at least 30% of each vehicle visible above roadway barriers for true sensor detection.

Ensure average speed data is accurate within 5 MPH for any direction of traffic for all conditions involving more than 16 vehicles in an averaging interval. Ensure speed accuracy for individual lanes is within 10 MPH of actual for all traffic conditions and similar intervals. Provide true speed detection without the requirement to enter average vehicle lengths for the speed calculation.

Ensure speed data is accurate for individual vehicle measurements. Ensure 50% of all measurements are within one MPH of actual, and 85% is within 5 MPH.

Ensure occupancy data is accurate within 20% of the actual occupancy for any lane when occupancy is less than 30%. For example, if the actual occupancy in a lane is 20%, the measured occupancy must be between 16% and 24%.

Ensure classification data is accurately determined for 90% of detected vehicles.

Provide test data, using methods required in Section 3.F., demonstrating or proving performance.

- 2.2. **Performance Maintenance.** Provide RVSD that does not require cleaning or adjustment to maintain performance. Ensure it does not rely on battery backup to store configuration information. Ensure the RVSD, once calibrated, does not need recalibration to maintain performance over entire operational temperature range unless the roadway configuration changes. Provide remote connectivity to the RVSD to allow operators to change the unit's configuration, update the unit's firmware programming and recalibrate the unit automatically from a centralized facility.

- 2.3. **Cabling.** Supply the RVSD with a connector cable of the appropriate length for each installation site.

Ensure the connector meets the MIL-C-26482 specification. Provide an environmentally sealed shell backshell that offers excellent immersion capability, and is designed to interface with the appropriate MIL-C-26482 connector. Encase all conductors that interface with the connector in a single jacket and ensure the outer diameter of this jacket is within the backshell's cable O.D. range to ensure proper sealing. Ensure the backshell has a clampbar style strain relief with enough strength to support the cable slack under extreme weather conditions. Provide the MIL-C-26482 connectors that provide contacts for all data and power connection.

If communication is conducted over the RS-485 or RS-232 bus, the communication cable must be Belden 9331, or an equivalent cable with the following specifications:

- Shielded, twisted pairs with a drain wire
- Nominal Capacitance Conductor to Conductor @ 1Khz  $\leq$  26pF/Ft
- Nominal Conductor DC Resistance @ 68°F  $\leq$  15 ohms/1000Ft
- Single continuous run with no splices allowed
- Terminated only on the two farthest ends of the cable

- 2.4. **Communication.** Ensure that the RVSD provides communication options that include RS-232, RS-485 or TCP/IP. Provide a RVSD which has the ability to support a variety of baud rates from 9600 to 115200.

Ensure the RVSD provides built in RS-232, RS-485 and an internal serial communication port. Each communication port must support all of the following baud rates: 9600, 19200, 38400, 57600 and 115200. Additionally, the RS-232 port must be full-duplex and must support true RTS/CTS hardware handshaking for interfacing to various communication devices.

**Data Packets.** The RVSD must produce data packets containing, as a minimum:

- One or more detection zones
- Collection interval durations
- Sensor ID
- 32-bit time stamps indicating end of collection interval
- Total volume by detection zone
- Average speed in each detection zone during the collection interval. Speed value units must be selectable as either miles per hour or kilometers per hour
- Occupancy in each detection zone during the collection interval, reported in 0.1% increments
- A minimum of 3 vehicle classifications reported as number of vehicles of each classification identified in each detection zone during the collection interval

- 2.5. **Operating System Software.** Provide the RVSD to also include graphical user interface software that displays all configured lanes and provides visual representation of all detected vehicles. The graphical interface must operate on current Department core operating system software. The software must automatically select the correct baud rate and serial communication port from up to 15 serial communication ports. The software must also operate over a TCP/IP connection and support a dial-up modem connection.

When required to interface with Traffic Management Center software, the RVSD system software must meet Transportation Sensor Subsystem Protocol requirements as documented in latest version available on the Department's website.

The software must give the operator complete control over the configuration process.

The operator must have the ability to save the configuration information to a file or reload the RVSD configuration from a file using the graphical user interface software.

Using the installation software the operator must be able to:

- change the baud rate on the sensor by selecting baud rates from 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 from none to RTS/CTS and vice versa.

The operator must be able to upload new firmware into non-volatile memory of the RVSD over any supported communication channel including TCP/IP networks.

- 2.6. **Software.** Provide all programming and software required to support the RVSD system. Install the programming and software in the appropriate equipment at the time of acceptance testing. Complete and pass acceptance testing using a stable release of the programming and software provided.

Provide software updates free of charge during the warranty period.

- 2.7. **Manufacturing Requirements.** Ensure the assembly of the units adheres to industrial electronic assembly practices for handling and placement of components.

The RVSD must undergo a rigorous sequence of operational testing to ensure product functionality and reliability. Include the following tests:

- Functionality testing of all internal subassemblies
- Unit level burn-in testing of 24 hours duration or greater

■ Final unit functionality testing prior to shipment

Provide test results and all associated data for the above testing, for each purchased RVSD by serial number. Additionally, maintain and make available manufacturing data for each purchased RVSD by serial number.

Externally, the RVSD must be modular in design to facilitate easy replacement in the field. Ensure the total weight of the RVSD does not exceed 5 lbs.

Ensure all external parts are protected against corrosion, fungus growth and moisture deterioration.

- 2.8. **FCC.** Ensure the RVSD has Federal Communications Commission (FCC) certification. Display the FCC-ID number on an external label. Ensure each RVSD is Federal Communications Commission (FCC) certified under CFR 47, Part 15, section 15.245 or 15.249 as a field disturbance sensor. Display this certification on an external label on each device according to the rules set out by the FCC.

Provide the RVSD system that is FCC certified under Part 15, Subpart C, Section 15.245 or 15.249 for low-power, unlicensed, continuous radio transmitter operation. Assure that the RVSD system will not cause harmful interference to radio communication in the area of installation. If the operation of the RVSD system causes harmful interference, correct the interference at the Contractor's expense.

Provide the RVSD that transmits in the 10.50 – 10.55 GHz or 24.00 – 24.25 GHz frequency band and meets the power transmission and frequency requirements specified under sections 15.245 and 15.249 of CFR 47 across the operating temperature of the device and over time as the sensor ages.

Provide documentation proving compliance to all FCC specifications.

- 2.9. **Support.** Ensure installers and operators of the RVSD are fully trained in the installation, auto-configuration and use of the device.

The manufacturer must train installers and operators to correctly perform the tasks required to ensure accurate RVSD performance. The amount of training necessary for each project will be determined by the manufacturer (not less than 4 hours) and must be included, along with training costs, in the manufacturer's quote. In addition, provide technical support to provide ongoing operator assistance.

- 2.10. **Power Requirements.** Provide the RVSD that operates either at 12 VDC to 28 VDC or at 12 VAC to 24 VAC from a separate power supply to be provided as part of the bid item and ensure it does not draw more than 10 watts of power each.

Provide the separate power supply or transformer that operates from 115 VAC  $\pm 10\%$ , 60 Hz  $\pm 3$  Hz.

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.

- 2.11. **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.

- 2.12. **Transient Suppression.** Provide DC relays, solenoids and holding coils that have diodes or other protective devices across the coils for transient suppression.

- 2.13. **Power Service Protection.** Provide equipment that contains readily accessible, manually re-settable 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.

- 2.14. **Fail Safe Provision.** Provide equipment that is designed such that the failures of the equipment will not cause the failure of any other unit of equipment. Ensure automatic recovery from power failure will be within 15 sec. after resumption of power.

- 2.15. **Mechanical Requirements.** Enclose the RVSD in a Lexan polycarbonate, ultraviolet resistant material. The unit must be classified as watertight according to the NEMA 250 Standard.

Provide the RVSD that will withstand a drop of up to 3 ft. without compromising its functional and structural integrity.

Do not use silicone gels or any other material for enclosure sealing that will deteriorate under prolonged exposure to ultraviolet rays. Ensure the overall dimensions of the box, including fittings, do not exceed 13 in. x 9 in. x 9 in. Ensure the overall weight of the box, including fittings, does not exceed 15 lbs.

Coat all printed circuit boards with a clear-coat moisture and fungus resistant material (conformal coating).

Ensure external connection for telecommunications and power be made by means of a single military style multi-pin connector, keyed to preclude improper connection.

- 2.15.1. **Modular Design.** Provide equipment that is modular in design to allow major portions to be readily replaced in the field. Ensure modules of unlike functions are mechanically keyed to prevent insertion into the wrong socket or connector.

Identify modules and assemblies clearly with name, model number, serial number and any other pertinent information required to facilitate equipment maintenance.

- 2.15.2. **Connectors and Harnesses.** Provide external connections made by means of connectors. Provide connectors that are keyed to preclude improper hookups. Color code and appropriately mark 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 pins and mating connectors that are plated to improve conductivity and resist corrosion. Cover connectors utilizing solder type connections by a piece of heat shrink tubing securely shrunk to insure that it protects the connection.

- 2.15.3. **Environmental Requirements.** Provide RVSD capable of continuous operation over a temperature range of -35°F to +165°F and a humidity range of 5% to 95% (non-condensing).

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### 3. CONSTRUCTION

- 3.1. **General.** Provide equipment designed and constructed 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. **Mounting and Installation.** Install the RVSD according to manufacturer's recommendations to achieve the specified accuracy and reliability.

Verify, with manufacturer assistance, the final RVSD placement if the RVSD is to be mounted near large planar surfaces (sound barrier, building, parked vehicles, etc.) that run parallel to the monitored roadway.

Include, at a minimum, radar detector unit, enclosures, connectors, cables, junction box, mounting equipment and hardware, controller interface boards and assemblies, local and remote software, firmware, power supply units and all other support, calibration, and test equipment for the RVSD system.

Furnish the RVSD with bracket or band designed to mount directly to a pole or overhead mast-arm or other structure. Ensure the mounting assembly has all stainless steel, or aluminum construction, and supports the load of the RVSD. Incorporate for the mounting assembly a mechanism that can be tilted in both axes, then locked into place, to provide the optimum area of coverage. Ensure the mounting bracket is designed and installed to prevent sensor re-positioning during 80 mph wind conditions.

Proper placement, mounting height and orientation of the RVSD systems must conform to the manufacturer's published requirements for the system provided. Install the RVSD units as shown on the plans. Analyze each proposed pole location to assure that the RVSD installation will comply with the manufacturer's published installation instructions. Advise the Engineer, before any trenching or pole installation has taken place, of any need to move the pole from the location indicated in the plans in order to achieve the specified detector performance. Confirm equipment placement with the manufacturer before installing any equipment.

Ensure alignment, configuration and any calibration of the RVSD takes less than 15 minutes per lane once mounting hardware and other installation hardware are in place. Install RVSD units such that each unit operates independently and that detectors do not interfere with other RVSD units or other equipment in the vicinity.

- 3.3. **Electronic Components.** Provide electronic components in accordance with Special Specification, "Electronic Components."
- 3.4. **Mechanical Components.** Provide external screws, nuts and locking washers that are stainless steel. 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.
- 3.5. **Documentation Requirements.** Provide documentation in accordance with Article 4, Special Specification, "Testing, Training, Documentation, Final Acceptance, and Warranty."

Provide documentation ensuring emissions from the RVSD equipment are not harmful to the public.

Provide additional test reports, for each of the following requirements:

- 3.5.1. **NEMA 4X Testing.** The RVSD enclosure must conform to test criteria set forth in the NEMA 250 Standard for Type 4X enclosures. Provide third party enclosure test results for each of the following specific Type 4X criteria:
- External Icing (NEMA 250 Clause 5.6)
  - Hose-down (NEMA 250 Clause 5.7)
  - 4X Corrosion Protection (NEMA 250 Clause 5.10)
  - Gasket (NEMA 250 Clause 5.14)
- 3.5.2. **NEMA TS2-1998 Testing.** The RVSD must comply with the applicable standards stated in the NEMA TS2-1998 Standard. Provide third party test results for each of the following specific tests:
- Shock pulses of 10g, 11 ms half sine wave
  - Vibration of .5 Grms up to 30 Hz
  - 300 V positive/negative pulses applied at 1 pulse per second at minimum and maximum DC supply voltage
  - Cold temperature storage at -49°F for 24 hours

- High temperature storage at +185°F for 24 hours
- Low temp, low DC supply voltage at -30°F and 10.8 VDC
- Low temp, high DC supply voltage at -30°F and 26.5 VDC
- High temp, high DC supply voltage at 165°F and 26.5 VDC
- High temp, low DC supply voltage at 165°F and 10.8 VDC

- 3.6. **Testing.** Perform testing in accordance with Article 2, Special Specification, "Testing, Training, Documentation, Final Acceptance, and Warranty." Test all RVSD to ensure that they comply with all FCC and Department specifications.

Ensure the RVSD meets functional performance requirements of Section 2.A (Sensor Performance) by the following methods:

Verify volume accuracy by performing a manual count on each lane of detection. When compared to the manual counts, the sensor counts must meet performance requirements as stated in Section 2.A.

Verify speed accuracy with laser speed gun provided by TxDOT, radar gun provided by contractor, or by video speed trap using the frame rate as a time reference. Vehicle speeds should be collected and averaged over a minimum of 10 vehicles. When compared to the average speeds collected via laser, the sensor speed data must meet performance requirements as stated in Section 2.A.

- 3.7. **Experience Requirements.** The contractor or subcontractor involved in the installation and testing of the RVSD must, as a minimum, meet the following experience requirements:

Two years continuous existence offering services in the installation of RVSD systems.

Two installed RVSDs where systems have been in continuously satisfactory operation for at least 1 year. Submit as proof, photographs or other supporting documents, and the names, addresses and telephone numbers of the operating personnel of the business or agency owning the system who can be contacted by the Department regarding the system.

Provide necessary documentation of contractor or subcontractor qualifications pursuant to contract award.

- 3.8. **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 RVSD equipment installation and communication system configuration.

Do not execute the initial powering up of the RVSD without the permission of the manufacturer's representative.

- 3.9. **Training.** Provide training in accordance with Article 3, Special Specification, "Testing, Training, Documentation, Final Acceptance and Warranty."

- 3.10. **Warranty.** Provide a warranty in accordance with Article 6, Special Specification, "Testing, Training, Documentation, Final Acceptance and Warranty."

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## 4. MEASUREMENT

This Item will be measured as each unit complete in place.

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## 5. PAYMENT

The work performed and material furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Radar Vehicle Sensing Device." This price is full compensation for furnishing all equipment described under this Item with all cables, connectors, mounting

assemblies, interface devices; all documentation and testing; all labor, materials, tools training, warranty, equipment, and incidentals.

# Special Specification 6062

## Intelligent Transportation System (ITS) Radio



### 1. DESCRIPTION

Furnish, install, remove, or relocate an Intelligent Transportation System (ITS) radio at locations shown on the plans, or as directed.

### 2. MATERIALS

Provide new materials that comply with the details shown on the plans and the requirements of this Item. Supply all equipment and hardware needed for a complete functioning system. Materials for equipment to be relocated will be "as-is". The Contractor will protect the existing equipment from further wear or damage.

### 3. EQUIPMENT

3.1. **General.** The ITS radio consists of a radio, power supply, antenna, antenna cables, lightning protection, grounding, all necessary mounting hardware, and radio configuration software.

Utilize the latest industry practiced techniques in equipment design and construction of parts, subassemblies, circuits, cards, and modules. Design equipment for ease of maintenance. Ensure that all component parts are readily accessible for inspection and maintenance, using hand tools. Provide test points for checking essential voltages, waveforms, signals, and similar data.

Ensure that all external screws, nuts, and locking washers are made of corrosion resistant material. Do not use self-tapping screws unless specifically approved by the Engineer.

Provide parts made of corrosion resistant material such as plastic, stainless steel, anodized aluminum, or brass.

Protect all materials used in construction from fungus growth and moisture deterioration.

Separate dissimilar metals by an inert dielectric material.

3.2. **Radio.** Each radio will be a point-to-point or point-to-multi-point single-band or dual-band radio operating in the license-free frequency as shown on the plans or as directed by the Engineer. Provide a radio that meets all of the following minimums:

3.2.1. **Frequency.** FCC unlicensed, 900 MHz, 2.4 GHz, or 5 GHz, as specified on the plans, or as directed;

3.2.2. **Channel Selection.** Dynamic Frequency Selection, with a manual override option;

3.2.3. **Minimum Range.** 15 mi., line of sight;

3.2.4. **Transmit Power.** User selectable, up to the maximum allowed by FCC rules, to at least 21 dBm, in 1 dBm steps (maximum step size). Maximum output power limited by FCC Part 15 rules for unlicensed frequencies;

3.2.5. **Receive Sensitivity.** Adaptive;

3.2.6. **Modulation.** Adaptive modulation and space diversity to provide maximum throughput;

- 3.2.7. **Forward Error Correction.** Provide forward error correction.
- 3.2.8. **Security.** Minimum security for the point-to-point backhaul network is the Advanced Encryption Standard, 128 bit block size (AES-128). Meet ISO/IEC 18033-3 standards. Minimum security for communications with Wi-Fi units is WPA2;
- 3.2.9. **Throughput.** Minimum out-of-the-box throughput of 100 Mbps for frequencies between 2.4 and 5 GHz. Minimum out-of-the-box throughput of 1 Mbps for the 900 Mhz frequency. Minimum measured throughput in the field of 50 Mbps for frequencies between 2.4 and 5 GHz;
- 3.2.10. **Networking Standards.** Provide at least the following:
- IEEE 802.1d – Ethernet Bridging,
  - IEEE 802.1p – Traffic Prioritization,
  - IEEE 802.1q – Virtual Local Area Network (VLAN),
  - IEEE 802.3 – 2012 Ethernet, and
  - IEEE 802.11-2009 – Wi-Fi (a/b/g/n) or most current version.
- 3.2.11. **Network Interface.** Minimum of one functional 10/100 Base-T RJ-45 port;
- 3.2.12. **On-Board Alignment Tools.** Provide a radio with on-board alignment tools for use aligning the antenna. These could be external LED indicators, audible indicators, or other approved mechanism; and
- 3.2.13. **FCC Certification.** Provide at least the following:
- FCC Part 15.400 (U-NII),
  - FCC Part 15.247 (ISM) 20 Mbps, and
  - FCC Part 15, Class B.

- 3.3. **Power.** Provide ITS radios meeting all specified requirements when the input power is 115 VAC  $\pm$  20%, 60 Hz  $\pm$  3 Hz, and that maximum power required does not exceed 35 W, including optional equipment.

Provide appropriate voltage conversion, power injectors, or other power supply hardware if the radio equipment or any radio-related ancillary devices require operating voltages other than 115 VAC or rely on Power over Ethernet (PoE or PoE+). Appropriate voltage converters or injectors must accept an input voltage of 115 VAC as noted above. Provide any required Power over Ethernet (PoE or PoE+) devices that are 802.3af-2003 or 802.3at-2009 compliant, meeting the power requirements of the radio equipment.

The Contractor will verify with the local power service provider to ensure that the provided equipment is compatible with the installed equipment. The Contractor will supply and install any additional equipment required for proper operation of the Radio System per the design.

Every numbered table and figure must be referenced in the accompanying text. Tables and figures should appear in the order they are referred to, no matter how fleeting the reference.

- 3.4. **Antennas.** Furnish and install radio antennas of the number and type specified on the plans, or as directed. These may include, but are not limited to:
- connectorized omni;
  - yagi;
  - sectorized (i.e. 45, 60, 90, 120 etc. degree increments);
  - parabolic antennas; and
  - integrated flat panel antennas.

Meet the following specifications:

- antenna gain as specified in the plans;

- minimum wind rating of 110 mph;
- Voltage Standing Wave Ratio (VSWR) value not exceeding 1.5 for the radio frequency specified on the plans;
- reflection coefficient value not exceeding 0.20;
- reflected power value not exceeding 4 %; and
- impedance matched to the impedance of the system so that voltage is in phase with the current.  
(Typically 50 ohms.)

3.5. **Antenna Coaxial Cables.**

3.5.1. **Nominal impedance.** Matched to the antenna's impedance to minimize the Voltage Standing Wave Ratio (VSWR). Typically 50 ohms.

3.5.2. **Maximum Attenuation.** 5 dB/100 ft. at the frequency specified on the plans.

3.5.3. **Maximum Cable Length.** 10 feet maximum length from radio to antenna when radio is mounted on an external structure. 100 feet maximum length from radio to antenna when radio is mounted in the cabinet and the antenna is mounted on the structure. Select external cable so that maximum cable attenuation is less than 5 dB total.

3.6. **Network Cable.** Provide Cat 5e shielded wire that meets the following minimum requirements:

- shielded twisted pair with drain wire;
- AWG24 solid bare copper;
- CMX outdoor rated for direct bury;
- outdoor UV rated jacket; and
- TIA/EIA-568B.2 and ISO/IEC 11801 standards.

Maximum run length for Cat 5e cable is 250 feet, or per the manufacturer's specifications.

3.7. **Lightning Protection.** Furnish and install surge protection on all coaxial cables mounted adjacent to and bonded to the cabinet ground bus. Include all mounting hardware necessary.

3.8. **Power Service Protection.** Provide equipment with readily accessible circuit protection devices (i.e. circuit breakers or fuses) for equipment and power source protection. Circuit protection devices may be resettable or replaceable.

Provide circuit breakers or fuses sized such that no wire, component, connector, PC board, or assembly will be subjected to sustained current in excess of their respective design limits upon the failure of any single circuit element of wiring.

Provide UL Listed Type 1 or Type 2 Surge Protection Device (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. Provide a SPD with integral EMI/RFI line filtering if shown on the plans.

Provide automatic recovery from power failure within 30 sec. after resumption of power.

Provide a GFCI duplex outlet for ITS radio equipment at existing locations as shown on the plans. Provide this outlet in addition to the existing outlets within the cabinet.

3.9. **Maximum Weight.** Provide equipment with a weight not exceeding 25 lbs.

3.10. **Maximum Dimensions.**

3.10.1. **Outdoor Units.** 16 in. x 16 in. x 9 in. for integrated units, not including antenna.

- 3.10.2. **Used in Cabinets.** Provide equipment that easily fits on a single shelf without cabinet modifications.
- 3.11. **Modular Design.** Provide a modular ITS radio System design to allow components to be readily replaced in the field.  
Label with UV resistant methods to identify all modules and assemblies with name, model number, serial number and any other pertinent information required to facilitate equipment maintenance.
- 3.12. **Network Topologies.** Point-to-Point or Point-to-Multi-Point, as shown on the plans, or as directed.
- 3.13. **Connectors and Harnesses.** All external connections will be made of connectors that are keyed uniquely to preclude improper hookups. Color code and label all cables to and from the connectors on both ends.  
Provide connecting harnesses of appropriate length and terminated with matching connectors for interconnection with the communications system equipment.  
Plate all pins and mating connectors with a minimum of 20 microns of metallic native element gold (Au). Use heat shrink tubing for all solder type connections to insure that it protects the connection from short circuiting.  
Label with UV resistant methods to identify all assemblies with name, model number, serial number and any other pertinent information required to facilitate equipment maintenance.  
Provide external waterproof connections that conform to IEC 60529 Section 14.2.7, or latest revision, for IP 66 or greater rating.
- 3.14. **Mechanical Requirements.** Provide equipment that is modular in design such that it can be easily replaced in the field.  
Label with UV resistant methods to identify each unit with name, model number, serial number and any other pertinent information required to facilitate equipment maintenance.  
Coat all printed circuit boards with a clear-coat moisture and fungus resistant material (conformal coating).
- 3.15. **Environmental Requirements.** Ensure that equipment conforms to NEMA TS2-2003 (R2008), International Electrotechnical Commission (IEC) 60529, and NEMA 250-2008, or most current version, for the following categories:
- 3.15.1. **Temperature and Humidity.** 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%; and
  - moisture condensation on all exterior surfaces caused by temperature changes.
- 3.15.2. **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 Hz to 30 Hz up to 0.5 g applied in each of 3 mutually perpendicular planes for 30 min.
- 3.15.3. **Shock.** Provide equipment that conforms to NEMA TS2 Section 2.1.10 and Section 2.2.4, or latest revision, 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 3 mutually perpendicular planes for 30 min.
- 3.15.4. **Environmental Contaminants.** Provide equipment that conforms to IEC 60529 Section 14.2.6, or latest revision, for IP 66 or greater rating when providing a pressurized unit.

Provide equipment that conforms to IEC 60529 Section 14.2.7, or latest revision, for IP 66 or greater rating when providing a non-pressurized unit.

- 3.15.5. **External Icing.** Provide equipment that is tested to conform to NEMA 250-2003 Section 5.6, or latest revision.
- 3.15.6. **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).
- 3.16. **Radio Configuration and Management Software.** Provide any and all programming and software required to make operational and support the radio system. The programming and software will be installed in the appropriate equipment at the time of acceptance testing, and will be used in the acceptance testing. Provide operations manuals, installation requirements, and licenses. Provide software with at least the following features:
- 3.16.1. **Radio Configuration.** Configuration is achieved through the following:
- a comprehensive configuration menu allowing the user to control all programmable radio settings;
  - a network tree which automatically discovers, organizes, displays, and searches for a radio; and
  - the ability to save individual radio configurations in a file that can be used to program replacement radios.
- 3.16.2. **Diagnostic Routines.** Provide the following diagnostic routines:
- 3.16.2.1. **Bandwidth Test.** For all communication links to a specific radio, including transmit and receive characteristics at the remote radios. Display signal strengths for transmit and receive. Provide client connection quality (CCQ);
- 3.16.2.2. **Spectrum Scan.** Determine the amount of background signal noise present for the specified frequency. Detect specific channels which experience interference to the extent that they are not adequate for the transmission or receipt of data. Include an option to exclude these frequencies from use; and
- 3.16.2.3. **Ping Test.** Measure and display the time it takes a packet of data to travel to and from another device in milliseconds and percent packet loss. Measure and display the variance in a minimum of seven successive ping tests (jitter).
- 3.16.3. **Networking Tools.** Provide the following network tools:
- provide a firewall configuration tool to manage multicast and broadcast traffic,
  - provide user selection of Spanning Tree Protocol (STP) and Rapid Spanning Tree Protocol (RSTP) options,
  - provide Virtual Local Area Network (VLAN) configuration tools;, and
  - provide Quality of Service (QoS) selection and configuration tools.
- 3.16.4. **Alarms.** Provide the following alarm features:
- provide 24 hr. monitoring of user selected alarms; and
  - provide option of sending email and text messages of triggered alarms.

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## 4. CONSTRUCTION AND WORK METHODS

- 4.1. **General.** Provide and install all materials, including support, calibration and test equipment, to ensure an operating and functional wireless radio system. This includes installation of power and data cables, and the power grounding and lightning suppression systems. Prior to beginning installation, inspect each site to verify suitability of the design for installation, grounding and lightning protection. Provide written documentation to the Engineer for approval prior to installation. Utilize the latest available industry standard construction

techniques with a minimum number of parts, subassemblies, circuits, cards, and modules to maximize standardization and commonality. Design equipment for ease of maintenance and orient component parts to be readily accessible for inspection and maintenance.

- 4.2. **Radio Mounting.** Provide and install all necessary radio mounts, standoffs, brackets, hardware, and grounding assemblies for the mounting surface shown in the plans. Install all radios at specified locations as shown on the plans. Any deviation between actual mounting location and those specified must be pre-approved by the Engineer.
- 4.3. **Antenna Mounts.** Provide and install all antenna mounts, standoffs, brackets, hardware, transmission line, hanger kits, grounding kits, and lightning suppressors for the mounting surface shown in the plans. Install all antennas at specified center lines. Perform antenna alignment for each path and compare with path calculations. Any variation between calculated and actual values must be brought to the attention of the Engineer.
- 4.4. **System Power and Grounding.** Prior to installation, provide a written description of the proposed grounding and lightning protection design. Connect the equipment to the 115 V circuits provided in the equipment cabinets at the sites. Bond all equipment racks in accordance with the approved manufacturer's installation specification. Ground all equipment racks to the single-point ground for the site. Provide grounding and lightning protection for all cable runs at the top of the support structure and at the equipment cabinet entry port. If the equipment cabinet and associated entry port is not collocated on the support structure, the grounding and lightning protection will also be provided at the bottom of the support structure.
- 4.5. **System Optimization.** Optimize equipment alignment and settings at each site to provide a complete, operational system.
- 4.6. **Conductors.** Provide conductors that meet the requirements of the most current version of the National Electrical Code (NEC) Provide conductors that are cut to proper length before assembly. It is not permissible to "double-back" conductors to take up slack inside the cabinet. Lace conductors neatly with nylon lacing or plastic straps. Organize conductors neatly inside the cabinet and secure cables with clamps. When connecting to hardware inside the cabinet, provide service loops at connection points. No splicing of cables or exposed conductors are allowed. Label with UV resistant methods to identify all conductors.
- 4.7. **Relocation.** 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 radio 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 radio equipment that fail inspection.

Prior to removal of existing radio 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 radio 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 components of the radio equipment or support structure damaged or lost will be replaced by the Contractor at no cost to the Department. Contractor to document and report to the Engineer 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 volts. The power connection will meet the requirements of the most current version of the NEC.

- 4.8. **Removal.** Disconnect and isolate any existing electrical power supply prior to removal of existing radio equipment.

Perform removal in strict conformance with the requirements herein stated and the lines, grades, details and dimensions shown on the plans. Completion of the work will present a neat, workmanlike, and finished appearance.

Any components of the radio equipment 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 designated on the plan sheets or general notes. The Contractor is fully responsible for any removed equipment until released by the Engineer.

- 4.9. **Contractor Experience Requirements.** Utilize installers, testers, and integrators with at least the following requirements:

- 4.9.1. **Minimum Experience.** Three years continuous existence offering services in the installation of wireless communications. Experience must include the following:

- 4.9.1.1. Conducting radio installation studies consisting of:

- signal noise studies,
- spectrum analysis,
- antenna gain / radio power calculations,
- system attenuation, and
- measurement of standing wave ratios.

- 4.9.1.2. Installation, troubleshooting and repair of broadband radio systems consisting of:

- equipment installation,
- configuration of radios,
- antenna calibration, and
- cabling.

- 4.9.1.3. Installation, troubleshooting, and repair of interconnected Ethernet networks (LAN and WAN) consisting of:

- cabling,
- switch / router configuration, and
- network analysis.

- 4.9.2. **Completed Projects.** Three projects consisting of wireless communications installation, troubleshooting and repair. Each project must include transmitting signals over a minimum of 1 mile distance and installation of a minimum of 3 devices.

- 4.9.3. **Equipment Experience.** One project (may be one of 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. 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.

- 4.10. **Documentation.**

Provide all licenses, where required, for any software or hardware in the system.

Provide a medical statement as to the safety of the unit to the general public (example: Pacemakers, etc.).

Provide proof of installer qualifications.

Provide all documentation described in this specification, including written reports for:

- verification of the suitability of the design for installation, grounding and lightning protection,
- communication link throughput tests,
- equipment grounding tests,
- system level test results to include: performance charts, link summaries, climatic factors, losses and standards, and
- wiring connection diagrams for the field installation and central installation.

#### 4.11. **Testing.**

4.11.1. **New Installations.** Unless otherwise shown on the plans, perform the following tests on the applicable equipment or systems.

4.11.1.1. **Test Procedures Documentation.** Provide 5 copies of the test plan procedures and target values, as well as blank data forms 60 days prior to testing for each test required in this specification. 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. 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 performed in testing by the contractor. Furnish data forms containing the acceptable range of expected results as well as the measured values.

4.11.1.2. **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.

Provide a copy of the certification to the District in which this equipment is installed. 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:

4.11.1.2.1. **Power Service Transients.** 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.

4.11.1.2.2. **Temperature and Condensation.** Meet 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 the NEMA TS2 standard, 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 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 the NEMA TS2 standard, Sections 2.2.7.5, "High-Temperature High Voltage Tests" and 2.2.7.6, "High-Temperature Low-Voltage Tests", or most current version.

- 4.11.1.2.3. **Relative Humidity.** Meet 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.
- 4.11.1.2.4. **Vibration.** Show no degradation of mechanical structure, soldered components, or plug-in components, and operate in accordance with the manufacturer's equipment specifications after being subjected to the vibration tests as described in the NEMA TS2 standard, Section 2.2.8, "Vibration Test", or most current version.
- 4.11.1.2.5. **Power Interruption.** Provide automatic recovery from power failure within 305 sec. after resumption of power.
- 4.11.1.3. **Demonstration Test.** Conduct a demonstration test on applicable equipment at an approved Contractor facility. The Contractor may submit procedures and results from previous projects in the same District as this project, provided the materials and equipment are identical. Provide previous procedures and results not more 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:
- 4.11.1.3.1. **Examination of Product.** Examine each unit carefully to verify that the materials, design, construction, markings and workmanship comply with the requirements of this Item,
- 4.11.1.3.2. **Continuity Tests.** Check the wiring to determine conformance with the requirements of the appropriate paragraphs in this Item, and
- 4.11.1.3.3. **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.
- 4.11.1.4. **Field Acceptance Test.** Following completion of equipment installation and operational optimization, submit an acceptance test plan to the Engineer for review and approval. During the official acceptance testing, provide the technical staff to conduct the measurements and adjustments called for in the testing. The Engineer will participate in the testing as the official test witness. Each page of the acceptance test document will provide for data recording of the test results, and the name of Contractor's representative conducting the test as well as a suitable field for the test date and signature of the Department's test witness. Upon the Engineer's approval of the test plan and the test schedule, the acceptance testing may begin.
- 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. Provide a factory certified representative for installation and testing of the equipment. Notify the Engineer 5 working days before conducting this test. The field acceptance test will consist of at least the following:
- 4.11.1.4.1. **Physical Construction.** Verify physical construction is completed in accordance with the plans and specification.
- 4.11.1.4.2. **Electrical Connections.** Verify that all connectors for grounding, surge suppression, and electrical distribution are tightened correctly and are quality connectors. Verify all power supplies and circuits are operating under the proper voltages. Verify all power and communications cables are terminated correctly, secured inside the cabinet, and fitted with appropriate connectors.

- 4.11.1.4.3. **Grounding.** Field test equipment grounding for all ITS radio equipment installed in the field and provide written documentation to the engineer. Where earth ground resistance values exceed 5 ohms, develop mitigation measures for consideration. Once mitigation measures are installed, re-test that ground and update the documentation.
- 4.11.1.4.4. **Interference.** Conduct a test site survey and interference analysis prior to the installation of the equipment. Measure the existing signal noise levels at each installation site for the proposed radio frequency, identify potential sources of interference, and document the findings in a written report to the engineer. The purpose of this survey is to verify that the parameters measured during the design process have not substantially changed. If the new survey indicates that the proposed radio system will not function as designed, develop proposed mitigation strategies. Adjust antenna polarities and channel plans on equipment to minimize interference from other sources.
- 4.11.1.4.5. **Communication Link Quality.** Conduct signal tests for each communication link, including data throughput, transmit power and frequency, receiver performance and frequency, proper operation of switch over, proper operation of alarm and switches, and bit error rate (BER). Document results in a written report to the engineer. Where measured throughput drops below 50 Mbps on any link, develop mitigation measures for consideration. Once mitigation measures, if any, are implemented on a communications link, re-test that link and update the documentation.
- 4.11.1.4.6. **System Paths.** Include the following in testing of the installed system paths:
- measure and record the transmitter/receiver channel frequency and polarity;
  - measure and record the transmitter power,
  - measuring and recording the receiver fade margin, perform a one hour Bit Error Rate Test (BERT) on the primary equipment and record results, and
  - verify the operation of all local alarm and control points using the alarm and monitoring equipment provided.
- 4.11.1.4.7. **Alarms.** Test and verify the operation of the alarms and monitor equipment in accordance with the acceptance test criteria.
- 4.11.1.5. **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's control software (when available) to perform subsystem testing. At a minimum, utilize this software to verify communication to the Department's equipment. 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

- 4.11.1.6. **Final Acceptance Test.** Following completion of the demonstration test, field acceptance 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.

Within 10 calendar days of the request, execute a data communications test using a Department supplied software program. 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 plan will

operate with application software provided by the Department or contractor supplied software approved by the Engineer.

Perform the data communications test for a period of 72 hr. Ensure that the test can be performed for a continuous 72 hr. during a normal work week. If a message error or component failure occurs anywhere in the network, restart the 72 hr. 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 special provision have been satisfied, contract time will be suspended and all subsystems will be placed into operation and operate as a complete ITS radio communication system as intended for at least 30 calendar 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 findings 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 at least 72 continuous hours during the 30 calendar day review period. If the number of defects or frequency of failures prevents all subsystems from operating as described above, the Engineer may reject the entire system integration test results and resume contract time. Provide any necessary corrections and resubmit system integration test results and a request to begin a final acceptance test which may include "as built" plans and a data communications test.

The project will not be accepted, notwithstanding other provisions in the Contract, 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.

- 4.11.1.7. **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 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. Malfunctions 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 at no additional cost to the Department or extension of time in contract period.

- 4.11.1.7.1. **Consequences of Design Approval Test Failure.** If the equipment fails the design approval test, correct the fault and repeat the design approval test until successfully completed.
- 4.11.1.7.2. **Consequences of Demonstration Test Failure.** If the equipment fails the demonstration test, correct the fault and repeat the demonstration test until successfully completed.
- 4.11.1.7.3. **Consequences of Field Acceptance Test Failure.** If the equipment fails the field acceptance test, correct the fault and repeat the field acceptance test until successfully completed.

- 4.11.1.7.4. **Consequence of System Integration Test Failure.** If the equipment fails the system integration test, correct the fault and repeat the systems integration test until successfully completed.
- 4.11.1.7.5. **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 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.
- 4.11.2. **Relocation and Removal.**
- 4.11.2.1. **Pre-Test.** Conduct performance testing prior to removal of radio equipment. Test all functional operations, identified in this Item, 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 Engineer. 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.
- 4.11.2.2. **Post Test.** Testing of the radio 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 radio 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 recorded 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. Provide 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 provide to the Engineer for review and either acceptance or rejection of equipment. Provide 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 radio system tests on the field equipment with the Department's central control software. The tests will, as a minimum, exercise all remote control functions and display the return status codes from the equipment.
- If any unit fails to pass a test, prepare a report and deliver the report 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 time to the contract period.
- 4.12. **Training.** Conduct a training class (minimum of 8 hr., unless otherwise noted in the plans) 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.
- 4.13. **Warranty.** Warrant the equipment against defects or failure in design, materials, and workmanship for a minimum of 3 years 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 ITS radio equipment with less than 100% 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.

Repair or replace any malfunctioning ITS radio equipment at the Contractor's expense prior to beginning the final acceptance test plan.

Repair or replace, at the manufacturer's option, defective equipment during the warranty period at no cost to the Department. Any replaced units will inherit the remainder of the failed unit's warranty period.

Furnish replacement parts and all equipment, with transportation prepaid, within 10 business days of notification of failure by the Department.

During the warranty period, provide technical support from the supplier. Provide this support within 4 hr. of request, and provided by factory certified personnel or factory certified installers of the equipment.

Provide ongoing software and firmware updates during the warranty period at no cost to the Department. All updates will be tested and approved by the Department prior to installation by the Department.

The Manufacture or the Contractor will maintain an inventory of parts to support maintenance and repair of all ITS radio equipment based on the terms of the warranty.

## 5. MEASUREMENT

This Item will be measured by each ITS radio furnished and installed, installed, relocated, or removed, of the types specified, to provide communication and functionality.

## 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 Radio" of the various types specified.

Types are defined as ITS RADIO X1 (X2/ X3) X4 (X5) where:

- X1 = Sngl (Single Band) or Dual (Dual Band)
- (X2/X3) = Frequencies Used (i.e. 5 GHz for single or 2.4 GHz or 5 GHz for dual)
- X4 = Antenna Configuration = I (Integrated) or C (Connectorized)
- (X5) = Antenna Type = O (Omnidirectional), U (Unidirectional), S (Sector), or P (Parabolic)

This price is full compensation for making fully operational an ITS radio at locations shown on the plans; all radio equipment, voltage converters or injectors, mounting brackets, hardware, cables and connectors; and all testing, training, software, equipment, labor, materials, tools, and incidentals.

- 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 Radio (Install Only)." This price is full compensation for making fully operational an ITS radio furnished by the Department at locations shown on the plans; and all testing, training, software, equipment, labor, materials, tools, and incidentals.
- 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 "Relocate ITS Radio." This price is

full compensation for relocating and making fully operational an existing an ITS radio as shown on the plans; and all testing, training, software, equipment, labor, materials, tools, , and incidentals.

- 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 "Remove ITS Radio." This price is full compensation for removing an existing ITS radio as shown on the plans; and all testing, training, software, equipment, labor, materials, 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 arrester into the circuit with size 8 AWG or larger stranded copper conductors. Connect arrester 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 <sup>1</sup>	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 UL 1449 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 ( $\pi$ ) 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**

<b>Circuit Description</b>	<b>Maximum Continuous Operating Voltage (MCOV)</b>	<b>Frequency/ Bandwidth/ Data Rate</b>	<b>Surge Capacity</b>	<b>Maximum Let-Through Voltage</b>
12 VDC	15-20 V	N/A	5 kA per mode (8x20 $\mu$ s)	<150 Vpk
24 VAC	30-55 V	N/A	5kA per mode (8x20 $\mu$ s)	<175 Vpk
48 VDC	60-85 V	N/A	5 kA per mode (8x20 $\mu$ s)	<200 Vpk
Coaxial Composite Video	4-8 V	Up to 1.5 GHz	10 kA per mode (8x20 $\mu$ s)	<100 Vpk
RS422/RS485	8-15 V	Up to 10 Mbps	10 kA per mode (8x20 $\mu$ s)	<30 Vpk
T1	13-30 V	Up to 10 Mbps	10 kA per mode (8x20 $\mu$ s)	<30 Vpk
Ethernet Data	7-12 V	Up to 100 Mbps	3kA per mode (10x1000 $\mu$ s)	<30 Vpk

- 2.7. **Environmental Design Requirements.** Provide cabinets that meet the functional requirements of this Item during and after subsection 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.

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### 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: 90° 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.

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## 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 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.

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### 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 indentation 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 90° 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.

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## 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  | ■ terminators | ■ cover       |
| ■ knockouts   | ■ adapters    | ■ load rating |
| ■ cable racks | ■ bolts       | ■ 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 90° 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.

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